MODERN BUILDINGS THEIR PLANNING CONSTRUCTION & EQUIPMENT

EDITED BY G A T MIDDLETON A R I B A

MODERN BUILDINGS

THEIR PLANNING, CONSTRUCTION AND EQUIPMENT

MODERN BUILDINGS

THEIR PLANNING, CONSTRUCTION AND EQUIPMENT

BY

G. A. T. MIDDLETON, A.R.I.B.A.

VICE-PRESIDENT OF THE SOCIETY OF ARCHITECTS

AUTHOR OF

"BUILDING MATERIALS" "STRESSES AND THRUSTS" "DRAINAGE OF TOWN AND COUNTRY HOUSES"
"THE PRINCIPLES OF ARCHITECTURAL PERSPECTIVE" SURVEYING AND SURVEYING INSTRUMENTS"
ETC. ETC.

ASSISTED BY A SPECIALLY SELECTED STAFF OF CONTRIBUTORS

PROFUSELY ILLUSTRATED

VOL. II

PART I. TOWN HOUSES, SHOPS, AND OFFICES
PART II. SPECIFICATION WRITING AND QUANTITY SURVEYING
PART III. THE CONSTRUCTIONAL FINISHINGS OF A BUILDING

LONDON
CAXTON PUBLISHING COMPANY, LIMITED
CLUN HOUSE, SURREY STREET, W.C.

Digitized by the Internet Archive
in 2015

https://archive.org/details/modernbuildingst02midd

LIST OF CONTENTS TO VOLUME II

PART I

TOWN HOUSES, SHOPS, AND OFFICES

CHAPTER I

PAGE

Terrace Houses without Basements 1

CHAPTER II

Large Town Houses 9

CHAPTER III

Semi-Detached Houses 17

CHAPTER IV

Workmen's Dwellings and Small Flats 20

CHAPTER V

Middle-Class Flats 24

CHAPTER VI

Offices and Shops 32

PART II

SPECIFICATION WRITING AND QUANTITY SURVEYING

CHAPTER I

Specification for a Draper's Shop 37

CHAPTER II

Quantities—General Principles and Sequence 49

CHAPTER III

PAGE

Quantities—"Taking-off" Carcase 55

CHAPTER IV

Quantities—"Taking-off" Finishings 68

CHAPTER V

Squaring, Collecting, and Abstracting 79

CHAPTER VI

Billing 89

PART III

THE CONSTRUCTIONAL FINISHINGS OF A BUILDING

CHAPTER I

Joinery Woods, Tools, and Methods of Working 95

CHAPTER II

Skirtings, Dados, and Panellings 107

CHAPTER III

Doors and Framings 114

CHAPTER IV

Window Framings, etc. 126

CHAPTER V

Cupboards and Bath and W.C. Enclosures 138

CHAPTER VI

Stairs and Stair Building 145

CHAPTER VII

External Plumbing 158

CHAPTER VIII

Drainage 164

CHAPTER IX

Sanitary Fittings and their Plumbing 171

CHAPTER X

PAGE
Glazing 180

CHAPTER XI

Floor Paving and Wall Lining 186

CHAPTER XII

Bells and Bell-Hanging 191

CHAPTER XIII

Plasterer 196

LIST OF COLOURED AND HALF-TONE PLATES IN VOL. II

Plate I.	Simnel Street and Castle Lane Site. Proposed Tenements. Detail of Houses (Coloured)	*Facing page*	20
,, II.	Marlborough Chambers, Jermyn Street, W. (Half-tone)	,,	32
,, III.	Design for a Draper's Shop (Coloured)	,,	36
,, IV.	Joiner's Details of Door and Window (Coloured)	,,	114
,, V.	Drain Plan of Suburban House (Coloured)	,,	164
,, VI.	East Window, Church of St. Matthias, Barbados (Coloured)	,,	184
,, VII.	Suggestions for Ornamental Tiles by the Pilkington Tile and Pottery Company (Coloured)	,,	186
,, VIII.	Mosaic Decoration, St. Alban's Church, Streatham Park, S.W. (Coloured)	,,	190

MODERN BUILDINGS

VOLUME II

PART I

TOWN HOUSES, SHOPS, AND OFFICES

CHAPTER I

TERRACE HOUSES WITHOUT BASEMENTS

THERE is much less scope for originality and diversity of plan in small town houses than in those erected in the country. The limiting conditions are very severe, especially if one takes the term "Town Houses" to mean such only as are built in terraces, considering all isolated houses as being, in effect, country houses, wherever they may be built. It is obvious that in terraces it is difficult to consider aspect at all, or prospect either. These have been laid down in advance by the formation of the roads along lines determined by other considerations. All that the architect can do is to light his rooms from front and back, it being almost impossible to open windows at the side unless they overlook similar windows in the neighbouring houses at a short distance away. Further than this, the building restrictions are generally very severe, much more so than in the country. They vary in different towns, but almost always contain stipulations determining the thickness of the walls, the provision of complete party walls separating house from house to prevent a fire from spreading from one to another; the heights of the rooms, and the construction generally being also definitely fixed.

At one time it was almost invariable to put some of the rooms in a basement, but this involves so much trouble in the service of the house that it has had to be abandoned, and a basement except for coals and perhaps for a larder is now rarely found, in small houses at any rate. The tendency with these is to build them with as few different floors as possible, so as to make them easy to work with a small staff of servants, or with none. This, of course, means that the houses must be extended over a considerable area of ground, and, as the frontage is usually strictly limited, this large area is only obtainable by extending the plan towards the back by means of what is called a back addition. Unfortunately this entails the formation of a narrow yard between the back addition of one house and the back addition of another, which is again cut in half by the fence dividing the two properties; and such a yard, unless very well kept, is little better than a slum. At all times it contains stagnant air, and in many instances is never penetrated by sunlight. Still, it seems to be unavoidable with small houses of limited frontage, for which a type of plan has been developed which it is difficult to depart from. Such a plan is shown in Fig. 1, which illustrates two of a row of small houses built at Sydenham, having each a frontage of 17 feet. In this case a parlour or drawing-room is placed in the front, though it may be remarked that this and the dining-room are interchangeable, either room being used for either purpose as may be desired. There is only a narrow front hall or passage, so as to give as much width as possible to the drawing-room, and the hall widens immediately the drawing-room is passed, to enable the staircase to be introduced. The kitchen is behind the drawing-room, entered beneath the staircase, and with its window overlooking the narrow

back yard. Three small cupboards are contrived, but only one of these has a window, and that is dignified

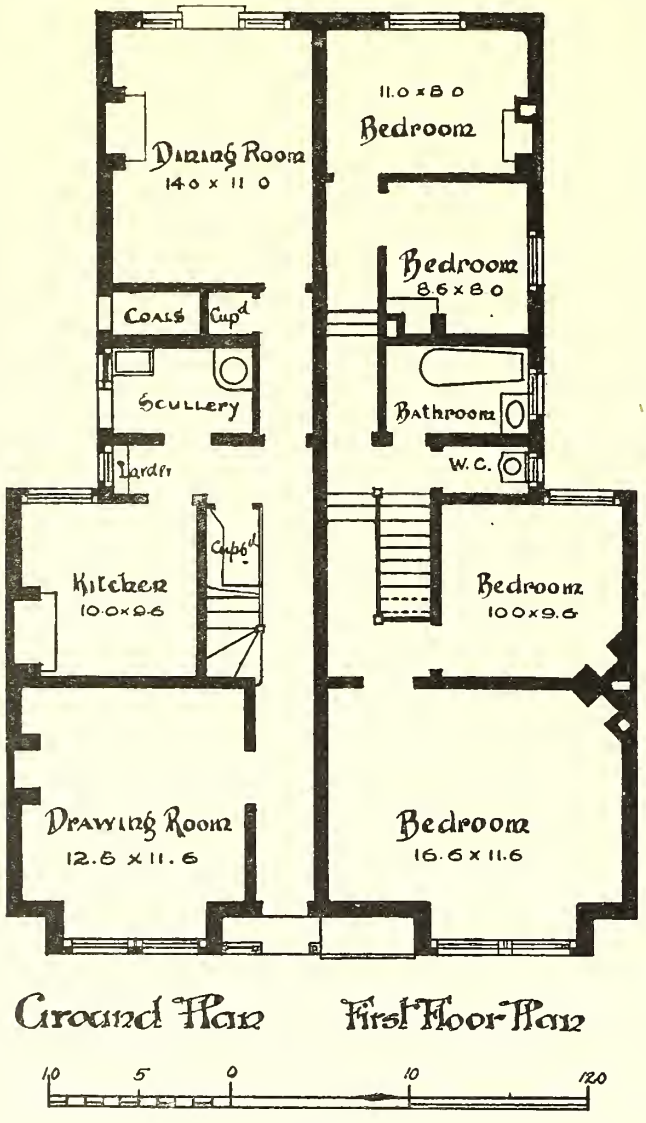


Fig. 1.

by the name of larder, while access to the yard is obtained through the scullery, and a very small coal cellar obtained behind it. It would be possible to put this cellar in a basement by sacrificing the store under the staircase—and this is perhaps more often done than not, as then the coals can be shot into the cellar from the front and not carried through the house. The dining-room is right at the back, and has windows opening out upon the garden. The two principal sitting-rooms thus face towards front and back, so that one or other of them obtains sunlight throughout a good part of the day, and advantage is taken of such prospect as can be secured over the street in front, and over the small garden in the rear. Upstairs a bath-room is obtained over the scullery, which is kept low, thus forming what is often called a half-landing, There is a separate w.c. over the larder—much better than placing it in the bathroom, as is often done to economise space. Three additional steps in either direction lead up to two bedrooms in the front, and two more at the back. Of these four bedrooms, two are only lit by windows opening into the back yard, while the windows of the other two face to front and back, they being over the drawing-room and dining-room respectively. It cannot be contended that this is an ideal plan, but it is probably as good as anything that can be managed under these very serious restrictions.

The rooms are small, but there are sufficient of them for many a small family, and such details as the positions of fireplaces, doors, and windows have been considered upon the lines already laid down in the last Volume, so as to secure as much comfort as possible in the various rooms, under very disadvantageous conditions. The principal inconveniences of such a house are the narrow hall and stairs, the narrow back yard with the overlooking windows, and the certainty that an inhabitant will hear a good deal that goes on in the neighbouring house. Serious as these are, however, there is no means of avoiding them, and they have to be submitted to almost universally.

A common modification of this plan is shown in Fig. 2, the principal alteration being that of putting the kitchen in the back addition; but the outlook from the dining-room is completely spoilt, and this is the more to be regretted as the frontage is sufficient for good rooms to be obtained, and much better could evidently have been done. Everything is on a larger scale, a third sitting-room being provided by placing the drawing-room on the first floor, where space is sacrificed in order to obtain light to the staircase. Such a house is, however, quite common, especially in the large towns of the North of England, for which it is planned, there being a detached wash-house and an e.c. at the back, near the exit to a back lane.

With a less increase of the frontage over that to which Fig. 1 is limited it is quite possible to produce a better plan; and a further modification is shown in Fig. 3, which is devised for a 22-feet frontage, almost entirely doing away with the back addition. The front hall in this case is made wide enough to contain the staircase, and it is not continued through. The dining-room is put in front and drawing-room at the back, the latter being of L shape, with the fireplace at the re-entering angle. This would be an awkward room to place a dining-table in, but quite convenient for purposes of recreation, there being a nicely warmed cosy recess behind the door, where possibly the piano might stand. The dining-room has its door at one corner and the fire-place in another, sheltered from the draught, and arranged so as not to be against the back of any person seated at the dining-table. In the kitchen, left-hand light is obtained to the range, while a good open space is provided for the table, and the scullery opens

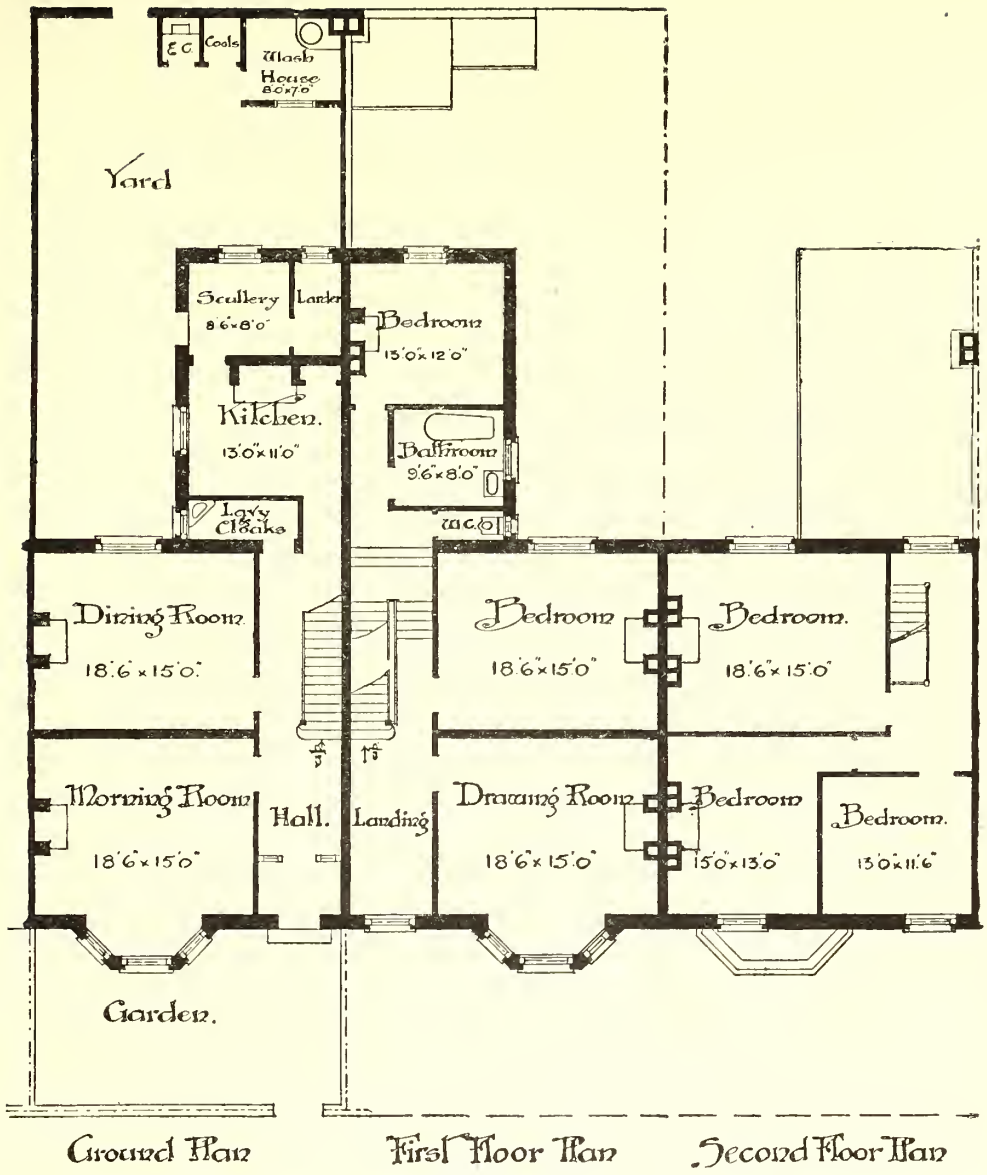


FIG. 2.

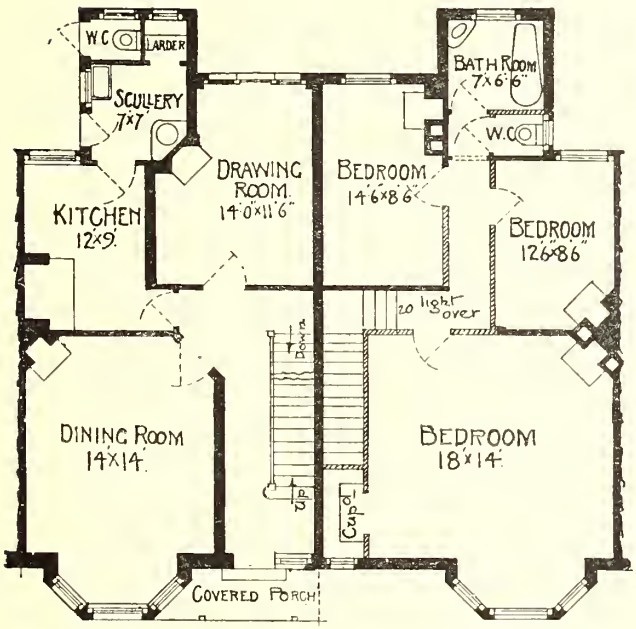


FIG. 3.

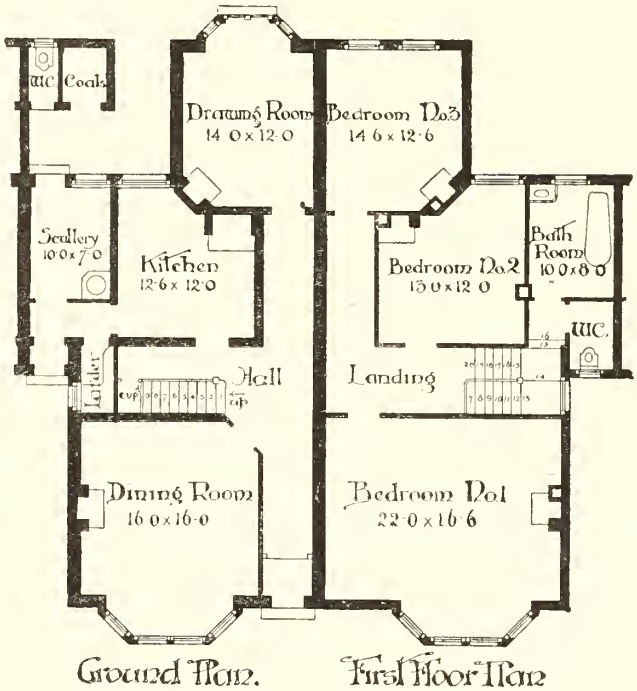


FIG. 4.

out of it with a small larder beyond. The coal cellar and possibly an additional larder can be provided in the basement. On the first floor there are three bedrooms and a bathroom, all fairly well lit, the front in the hall, but rising between the front dining-room and the kitchen. If this plan is adopted it is possible to arrange for a side entrance to the kitchen, in the manner which is shown. If the site be narrow, some

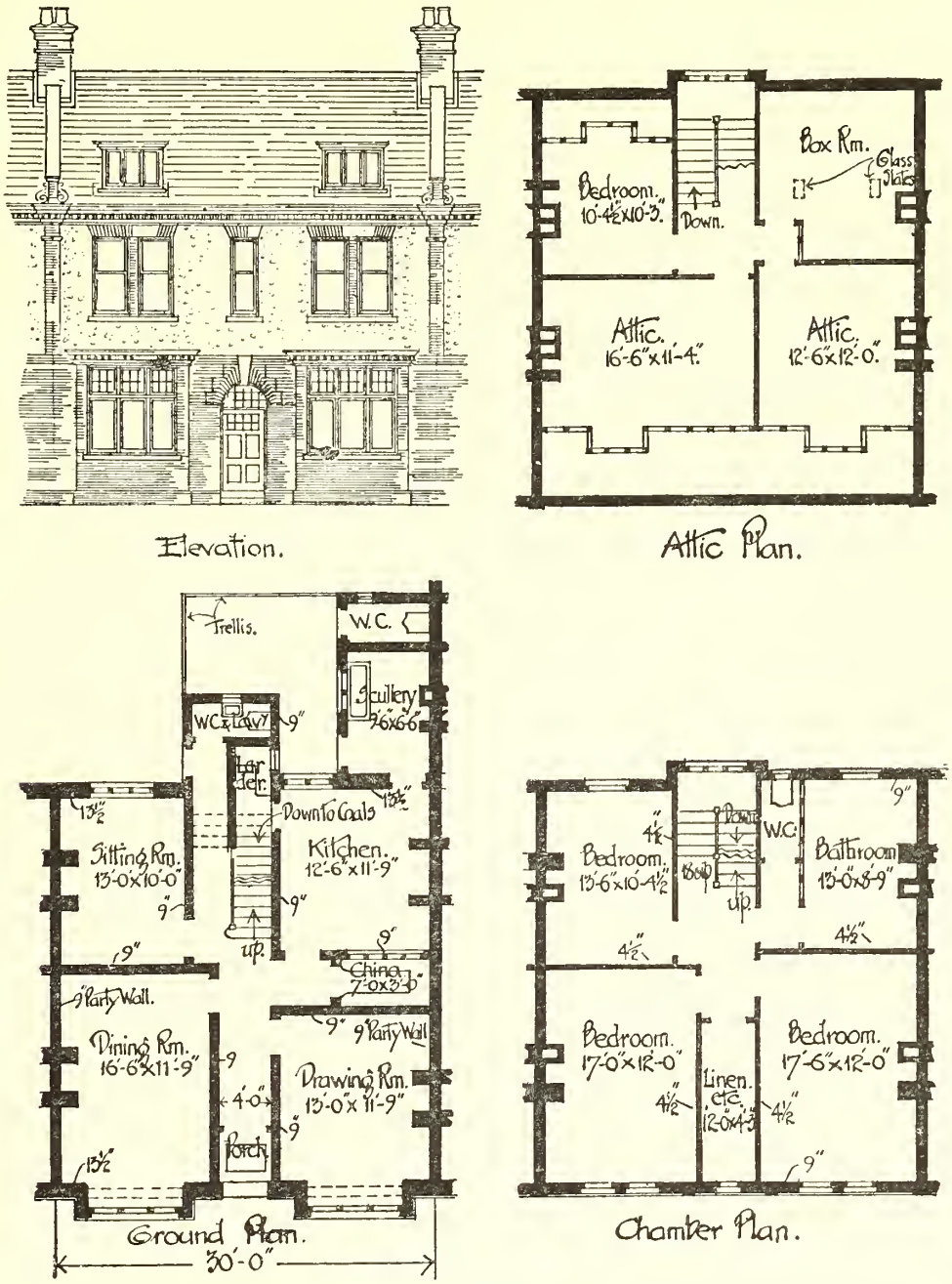


Fig. 5.

room extending right across the frontage, except for a small cupboard with a window to it if desired. If additional bedrooms were required the stairs would have to be carried up another flight, and in either case they would have to be lit from the top.

Another modification of the same plan is shown in Fig. 4, the staircase not now being placed lengthways difficulty arises in lighting the kitchen. As shown there is just room for a window, but this would not be the case if the site were narrower. The passage leading to the drawing-room is also dark, though a little light would filter through from the landing window, which is not very high up. A larder is obtained under the stairs from a back lobby, which

itself would only have borrowed light through a back door, or by glazing the doors leading to kitchen and scullery. The bathroom and w.c. are obtained off the half-landing, and are yet out of the way and disconnected from the rest of the house; but on the first floor there is again an ill-lit passage, unless the house be only two storeys in height when top lighting can be obtained. It is of course quite possible to add another floor, but this would darken the passages on the floors below.

This plan, which is by no means an uncommon one, can be largely improved by widening the hall so as to obtain a fireplace in it, and allowing for a well to the staircase and a much larger landing window. If this be done, half the present objections to the plan disappear, and a comfortable house results, especially if the dining-room fireplace is put in the corner and the draught from the door screened from it by a small projecting piece of wall.

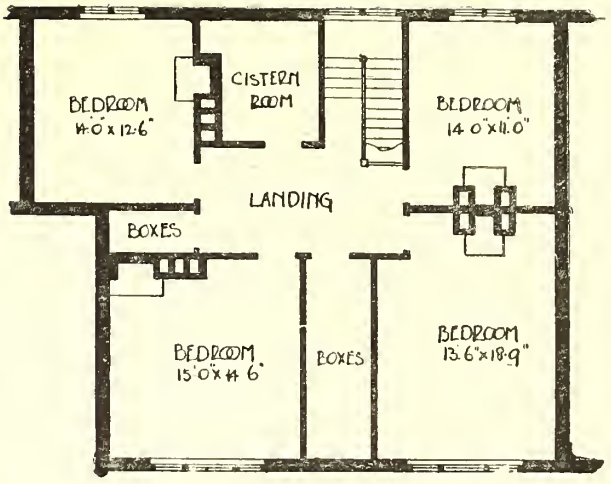
All the plans that have yet been illustrated in this chapter are what are known as "single-fronted" houses, *i.e.* they have a single sitting-room on one or the other side of the entrance; but another and now more common type is the double-fronted house illustrated in Fig. 5, having the two principal sitting-rooms to right and left of the entrance passage. The staircase generally rises centrally, either in the front passage, or at the back as it is here shown, and the third small sitting-room and a kitchen are obtained at the back, the former looking into a garden and the latter into a yard. A back entrance is contrived to the garden with w.c. beyond, and everything is arranged for back drainage. A small china closet is obtained between the drawing-room and the kitchen, and there is a larder at the top of the cellar stairs, separately lighted. On the first floor there are three bedrooms, bathroom, and linen-store, while on the floor above are three attic bedrooms, and a boxroom. As the staircase occurs at the back of the house, it is well lighted from top to bottom, and the house is well ventilated without draughts.

A comparatively narrow frontage of 30 feet has been chosen for the purpose of illustration, to show the sort of house that is usually built under such circumstances. It is not considered ideal in many respects, but it is roomy and cheap to build, and under a single span roof except for small back additions on the ground floor.

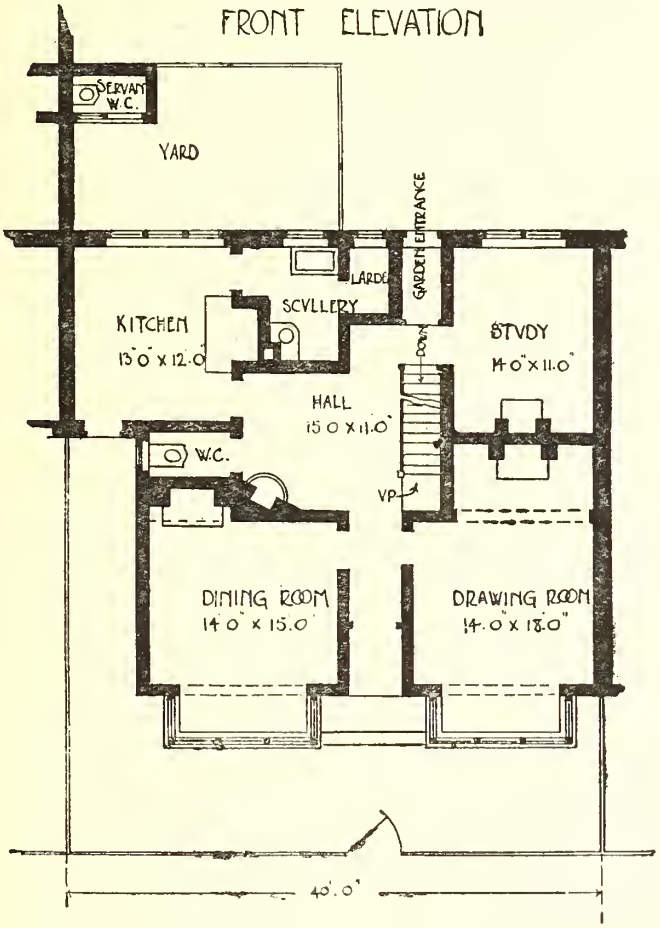
With a more extended frontage it is possible to do much better with this same type of plan, as is shown in Fig. 6. In this case there is a much larger and nearly square hall with a fireplace in it, the staircase rising centrally in the house, and the scullery being obtained under the main roof. A side entrance is contrived, so that there is no necessity for coals or dust to be carried through the middle of the house, having to traverse the kitchen only. It has been possible to give more consideration to the comfortable placing of the fireplaces, which in all the rooms are now cosily situated. The number of rooms is the same as in the previous case, but they are larger and more convenient. Probably such a house would cost little more than that last illustrated, but it would certainly fetch a higher rent, and be more comfortable to live in.

It will, of course, be noticed that aspect and prospect, as already said, have little to do with the planning of these houses. Bay windows give an opportunity for looking up and down the street as well as just in front, and a back room may look out on to a garden. Nothing more can be done, and houses have to be planned just the same for one side of the road as for the other, as it would be unsatisfactory to place a kitchen in the front or a principal sitting-room at the back.

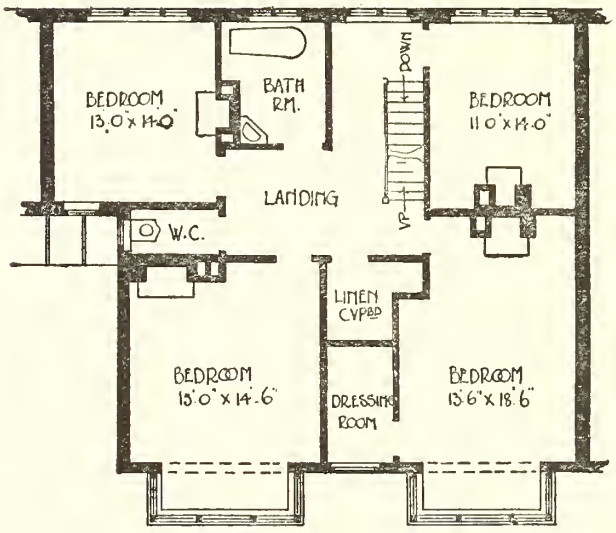
FRONT ELEVATION



ATTIC PLAN



GROUND FLOOR PLAN



FIRST FLOOR PLAN

1·0 5 10 15 20 25 30 35 40

Scale of Feet

FIG. 6.

CHAPTER II

LARGE TOWN HOUSES

The separation between the family and the servants, which is so easily managed in large country houses by extending over a large area, has to be secured by quite different means in the streets of great cities. It is only in very rare cases that ground is available for surface extension, and the necessary separation is obtained horizontally instead of vertically, and even then more or less imperfectly. As a general rule the principal entrance floor is raised somewhat above the street level, and is reached by a flight of steps which passes as a kind of bridge over a fairly wide area, which lies between the pavement and the house, and is utilised for lighting a series of lower basement rooms which are reserved for the kitchen and domestic offices. The servants therefore spend the daytime of their lives below the ground level, with practically no outlook to either back or front, while for sleeping they are generally banished to the top floor many storeys up; for the houses, being unable to extend laterally, are elongated upwards. It is not many years since moderate sized houses for the middle class were built upon this system, but of late they have given place to such houses as were described in the last chapter, or to flats, it being necessary under modern conditions of life to economise the service as much as possible. Servants dislike living in basements, and will not do so unless they are well paid, while a basement house crowded on to a small site, and many storeys in height, is necessarily an expensive one to work with its many stairs and great amount of carrying up and down.

Fig. 7 shows a comparatively small house designed upon the basement system. External stairs on the pavement level lead down to the front area, a servants' w.c. and a coal cellar being contrived under the street pavement, so that the coals can be shot down through circular holes covered with coal plates. A so-called "back" entrance for tradesmen and servants, lighted by the staircase window, is obtained under the main entrance, and on the basement floor are found housekeeper's room (or servants' sitting-room) and a good kitchen, scullery, wine cellar and larder. There is a back area for light, and projecting below the garden level is a room for boots and brushes. There are both stairs and lifts to the ground floor, this providing easy service. In older houses of this description a lift was rarely provided, but it has become an acknowledged necessity now, and should be carried from the basement at least to the ground-floor level, and preferably higher; though it is intended as a rule to be worked by hand power, and so is only capable of carrying light articles. The dining-room occupies the space over the kitchen and scullery, while a small study is obtained above the housekeeper's room with its fireplace in the corner, there being also a corner fireplace in the hall. It is generally impossible in such a house to do otherwise than put the dining-room fireplace in the middle of the room, although this is acknowledged to be awkward and lacking in architectural possibilities, but something can be done with the hall and study. It will be noticed that a covered bridge, with windows on either side, leads across the back area to a lavatory and w.c., thus properly air-disconnected from the house. On the first floor is found the drawing-room, extending from back to front over the dining-room, and the principal bedroom with an adjoining dressing-room or bathroom, while on the upper floors, of which there may be two or three, there are three bedrooms each, together with w.c. It will be noticed that such a house provides ample accommodation for a middle-class family requiring fairly good reception rooms, while being satisfied with a single staircase to serve all purposes.

A house of a larger kind is shown in Fig. 8, planned for a considerable frontage, enabling entrance to be made on the ground floor to a large hall having a window recess opposite to a fireplace, round which the stairs wind. Such a hall is capable of handsome treatment, and can be used as a reception apartment when desired. Out of this hall two large sitting-rooms are reached, one for use as a dining-room in the rear, and the other for a library at the front, while the servants' stairs are separately planned and well lighted, with a lift occupying the well-hole and passing right up the house. Cloakroom accommodation is obtained through a door underneath the staircase.

On the basement floor the kitchen is underneath the dining-room, and it has been possible to provide also a housekeeper's room, butler's room, and servants' hall, together with wine cellars and butler's pantry, while larders and scullery extend at the back under part of the garden. The whole of the kitchen arrangements are thus upon a sufficiently sumptuous scale for the accommodation of a considerable number of servants, while communication is easily obtained both by a lift and staircase.

The first floor is given over to a large reception

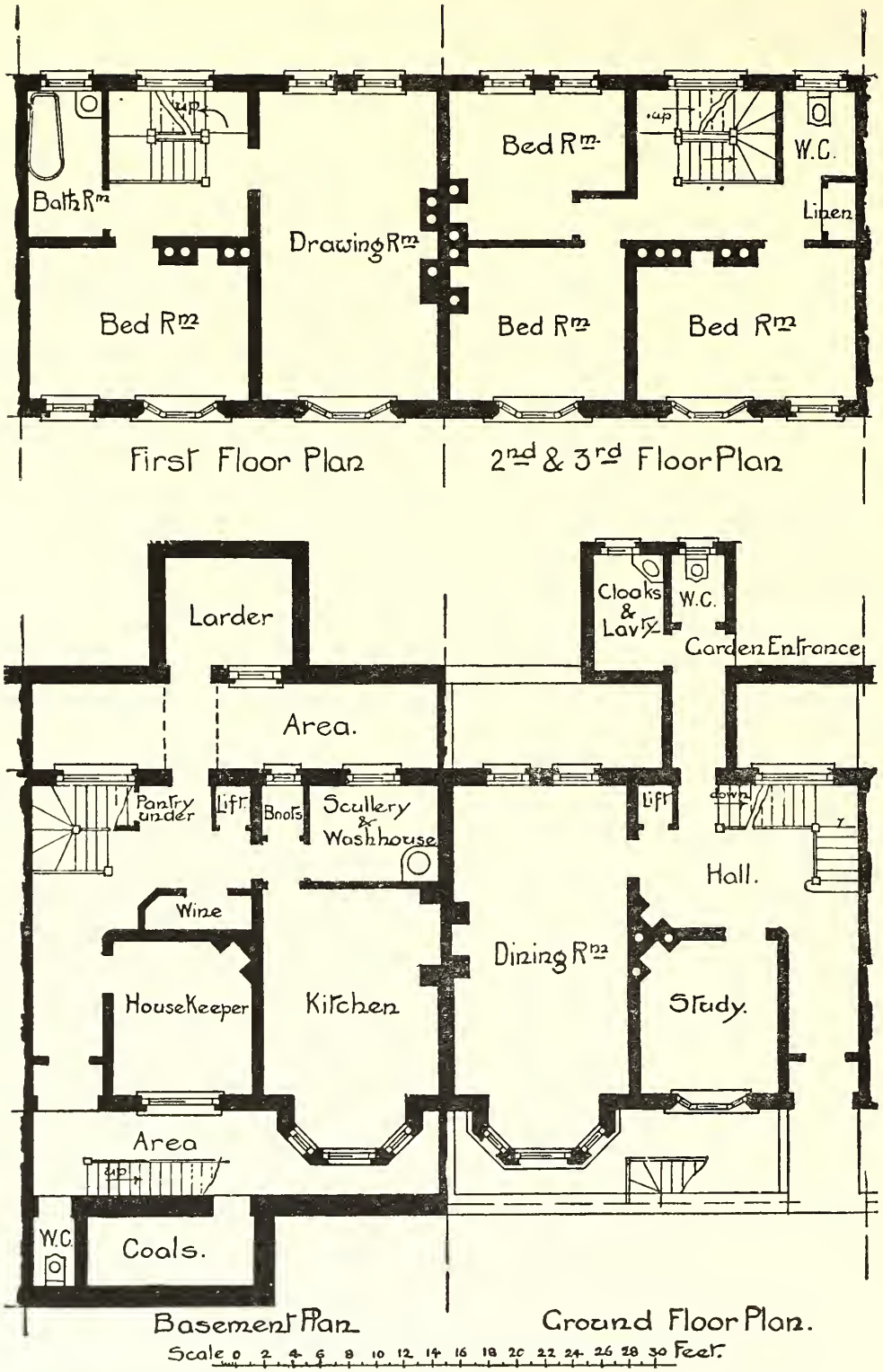


Fig. 7.

landing, and to a boudoir and drawing-room separated by folding doors, so that they can be thrown together when desired. The principal staircase rises no farther than the first floor, the bedrooms all being served by the servants' stairs. This seems to be a somewhat ignominious arrangement, but it is usual in large town houses.

Somewhat similar in its general ideas, but very clever in its arrangement, is the house in Berkeley Square designed by Messrs. Ernest George & Peto,

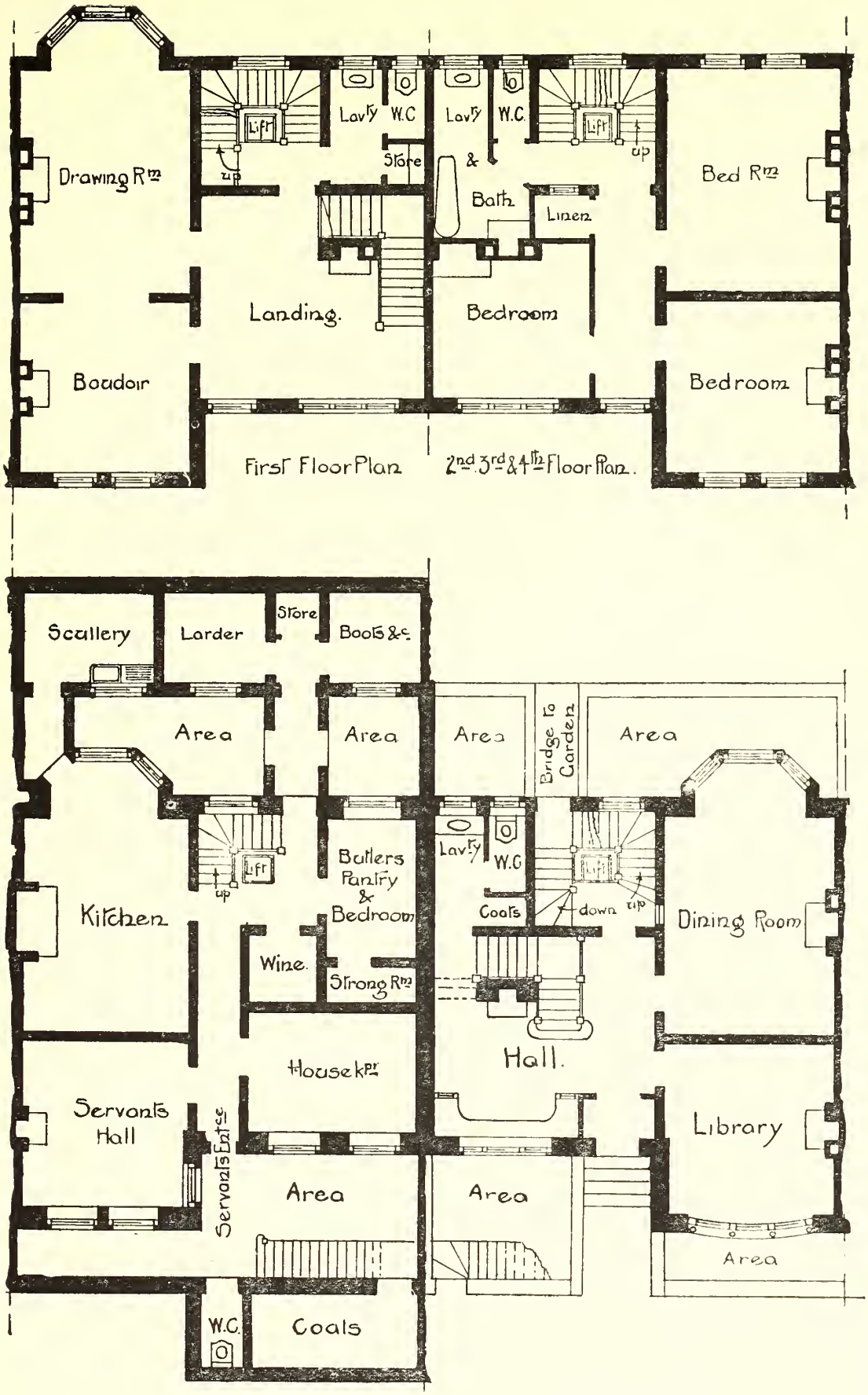

Drawing Rm
Lift
up
Lavty
W.C
Lavty
W.C.
Store
&
Bath
Linen
Lift
up
Bed Rm
Landing.
Bedroom
Boudoir
Bedroom
First Floor Plan
2nd 3rd & 4th Floor Plan.
Scullery
Larder
Store
Boots &c
Area
Area
Area
Bridge to Garden
Area
Lavty
W.C
Butlers Pantry & Bedroom
Lift
up
Kitchen
Coals
down
up
Dining Room
Wine.
Strong Rm
Housekpr
Hall.
Servants Hall
Servants Entce
Library
Area
Area
Area
W.C.
Coals
Basement
Ground Plan.

FIG. 8.

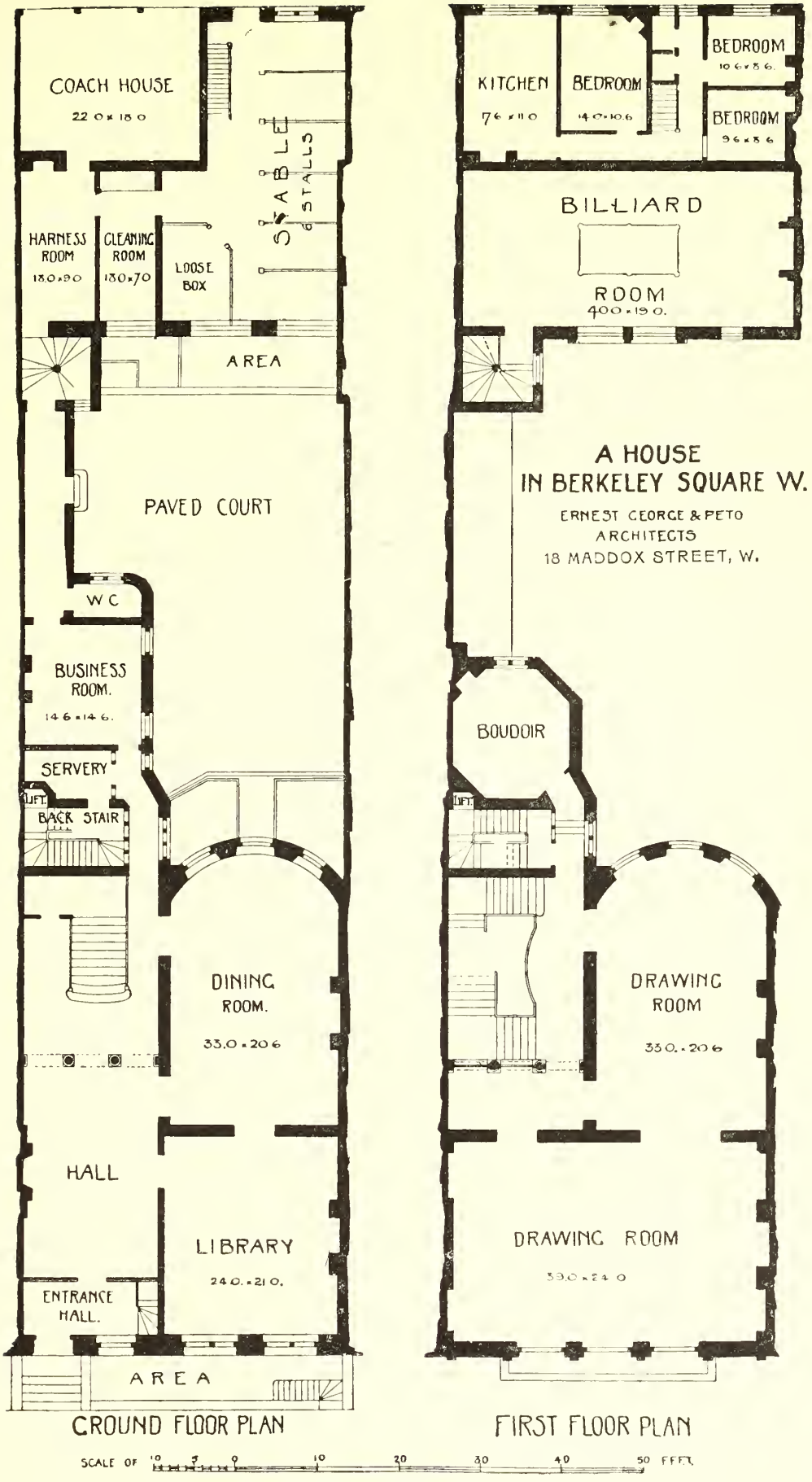

COACH HOUSE
22.0 × 18.0
STABLE
6 STALLS
HARNESS ROOM
13.0 × 9.0
CLEANING ROOM
13.0 × 7.0
LOOSE BOX
AREA
PAVED COURT
W.C
BUSINESS ROOM.
14.6 × 14.6.
SERVERY
LIFT
BACK STAIR
DINING ROOM.
33.0 × 20.6
HALL
LIBRARY
24.0. × 21.0.
ENTRANCE HALL.
AREA
GROUND FLOOR PLAN
KITCHEN
7.6 × 11.0
BEDROOM
14.0 × 10.6
BEDROOM
10.6 × 8.6.
BEDROOM
9.6 × 8.6
BILLIARD ROOM
40.0 × 19.0.
A HOUSE
IN BERKELEY SQUARE W.
ERNEST GEORGE & PETO
ARCHITECTS
18 MADDOX STREET, W.
BOUDOIR
LIFT
DRAWING ROOM
33.0. × 20.6
DRAWING ROOM
33.0 × 24.0
FIRST FLOOR PLAN
SCALE OF 10 5 0 10 20 30 40 50 FEET

FIG. 9.

shown in Fig. 9, for the comparatively narrow frontage of 40 feet. A small entrance hall or lobby, with a separate staircase to the basement for the use of the footmen, leads into a large hall, the light to which is obtained from above the staircase, which in this instance goes right up the house. The hall is separated into two parts by an arcade, and would make a fine apartment. The library opens out in the front, and the dining-room behind, with a narrow passage leading beside the main staircase to the back staircase and servery, and beyond that to a business room. The passage is continued even farther to a series of stables at the back, with an intervening staircase leading up to a billiard-room, which is thus well separated from the rest of the house. Although it forms no part of the matter with which we are dealing in this Volume, the clever planning of the stable, which opens on a back street, is noticeable. Six stalls and a loose box with cleaning-room, harness-room and coach-house are contrived in very little space, with a small house for a coachman and his family over the portion which faces the back street. On the first floor of the main building two drawing-rooms are arranged with connecting doors, but separate entrances for large reception purposes, while a small octagonal boudoir occupies the space above the servery and business room.

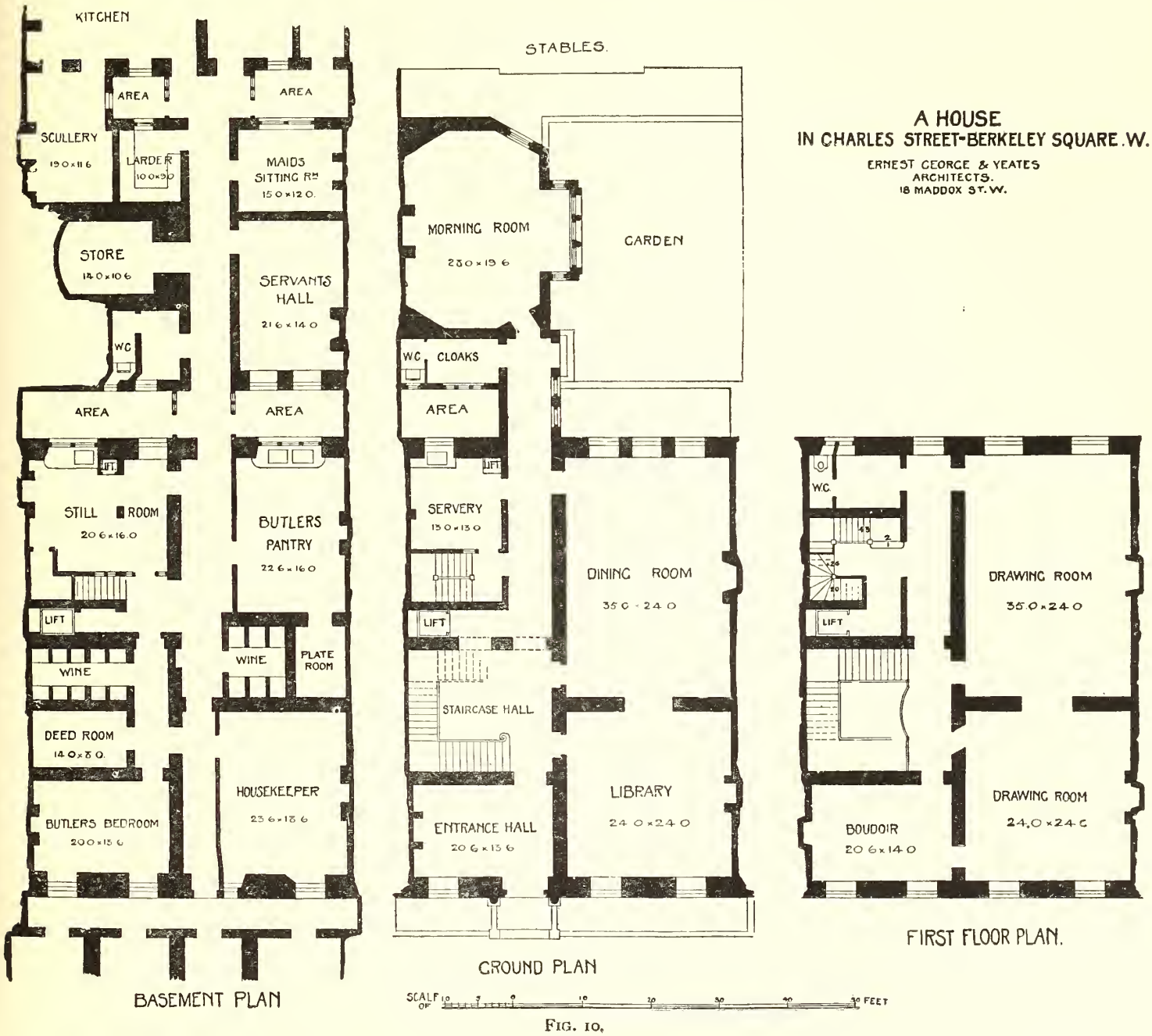


FIG. 10.

The same architects have produced a larger house in Charles Street, as shown in Fig. 10, for a somewhat larger frontage. The entrance hall is here distinct from the staircase hall, out of which the library and dining-room are reached, the former in the front and the latter at the back; and these have communicating doors. The lift is placed between the main staircase and that reserved for servants, while the servery, lighted from a back area, has a sink and a small lift from the still-room. A bridge across the back area leads to a morning-room of apparently irregular but really symmetrical shape, capable of good architectural treatment. In the basement the butler's room and housekeeper's room are in the front, and the butler's pantry with its plate-room and the still-room at the back, all the unlit middle portion being occupied by wine cellars and a strong room for deeds. The coals are as usual stored underneath the street pavement, and are carried up the house by a large service lift. A servants' hall and maids' sitting-room are obtained underneath the garden, being lighted from areas, as are also the larder and scullery, while the kitchen is in the extreme rear underneath the stables. On the first floor there are two large communicating drawing-rooms and a boudoir. The main staircase ends here, an area being formed above it so that it may be top lighted, and that side-lighted communication may be obtained to the various bedrooms, which are reached by a secondary staircase which is carried over the servants' staircase, but not in absolute continuation of it.

A house of this sort contains comparatively little sleeping accommodation, and is obviously intended to a large extent to be used for reception purposes, for which it is admirably suited. If many bedrooms are to be provided there must be several upper floors, and in spite of the lift the house then becomes difficult to work; and in any case communication with the kitchens can only be managed by means of speaking-tubes or telephone.

It will be noticed that all the principal apartments are planned symmetrically. There is no attempt to obtain cosy nooks or recesses, but a grander architectural effect is aimed at than these can provide. This it is possible to obtain without loss of comfort where the rooms are large. In good houses like this there is little draught. The door and window openings bear a comparatively small proportion to the floor area, and are distant both from one another and from the fireplaces, which are themselves by no means cramped closely against the dining-tables or other furniture. Considerations of small points of comfort need not, therefore, outweigh those of architectural effect, and dignified and pleasing results are secured by tolerably simple means.

CHAPTER III

SEMI-DETACHED HOUSES

SEMI-DETACHED houses partake about equally of the characteristics of separate houses such as were dealt with in the First Volume of this book, and of terrace houses. They generally occupy a comparatively open site, with pleasant prospects from the windows in two or three directions, and can be spread over a considerable area of ground. On the other hand, while prospects can be studied to some extent, the aspects are usually fixed, and houses have to be built so that of side lighting which ought to be obtained being thus thrown away, while sound may very well penetrate from one house to the next. Fig. 11 illustrates a house of this description. The entrance is at the side with a lavatory almost opposite the front door, while an inner hall containing a fireplace is reached by a turn to right or left. Out of this hall the study, drawing-room, dining-room, and kitchen all open, and all of them are shown with windows to the front or

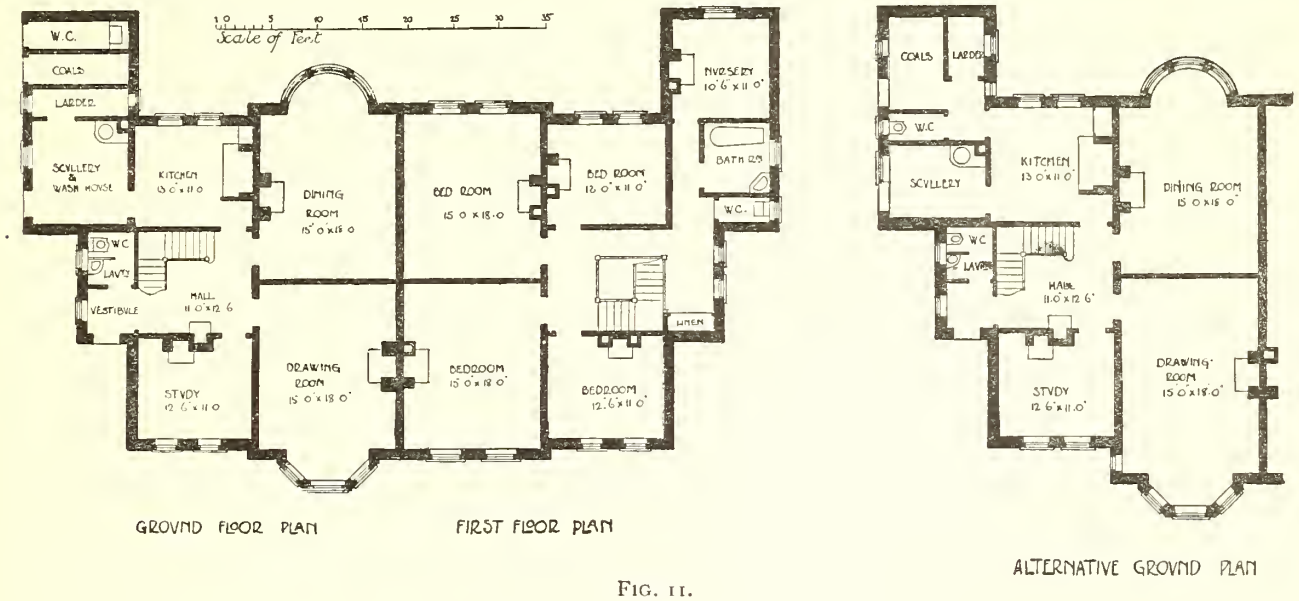


FIG. 11.

each corresponds exactly with its neighbour. Almost all the plans which have been illustrated in the two previous chapters could be adopted if the houses were semi-detached instead of being in rows, the only alteration necessary being the different placing of certain of the windows, which might now open in the side walls. It is rare, however, to find a semi-detached house with a basement which has been built within the last ten years, and such may consequently be put out of consideration altogether.

The most usual system of planning adopted is that of putting the principal rooms next to the party walls, in order that their fireplaces might be carried up together, thus securing internal flues and an economy of brickwork. Against these advantages there must be set the fact that only front and back windows are then obtainable to the principal rooms, the opportunity back only. The only advantage here gained over the terrace house is the fact that the staircase is well lighted from a good landing window, which throws plenty of light down into the large hall below; while the w.c., bathroom, and nursery are disconnected from the rest of the house, which is thereby kept quiet at all times. Only four bedrooms other than the nursery are shown, but the stairs could be carried up another floor if necessary. Such a house would be inexpensive to build and easy to work, yet the plan is hardly one which can be thoroughly recommended owing to the disadvantages already mentioned. It has, in fact, been left in a state of imperfect consideration deliberately, in order to show how further thought will often enable an apparently satisfactory plan to be greatly improved. Lateral windows, for instance, can be opened in the study and the bedroom

over it without any difficulty, and also on *both* sides of the nursery, which would thus be converted into a bright and sunny room, especially if it were given a projecting oriel on the side which obtained most sunlight and the best view. Similarly the drawing-room, and the bedroom over it, could obtain a lateral view if it were brought slightly more forward beyond the study, so as to obtain a side window. The dining-room fireplace is directly in the draught between the door and window, and impinges on the dining-table; while it could have been sunk into the small and now almost useless recess in the kitchen between the

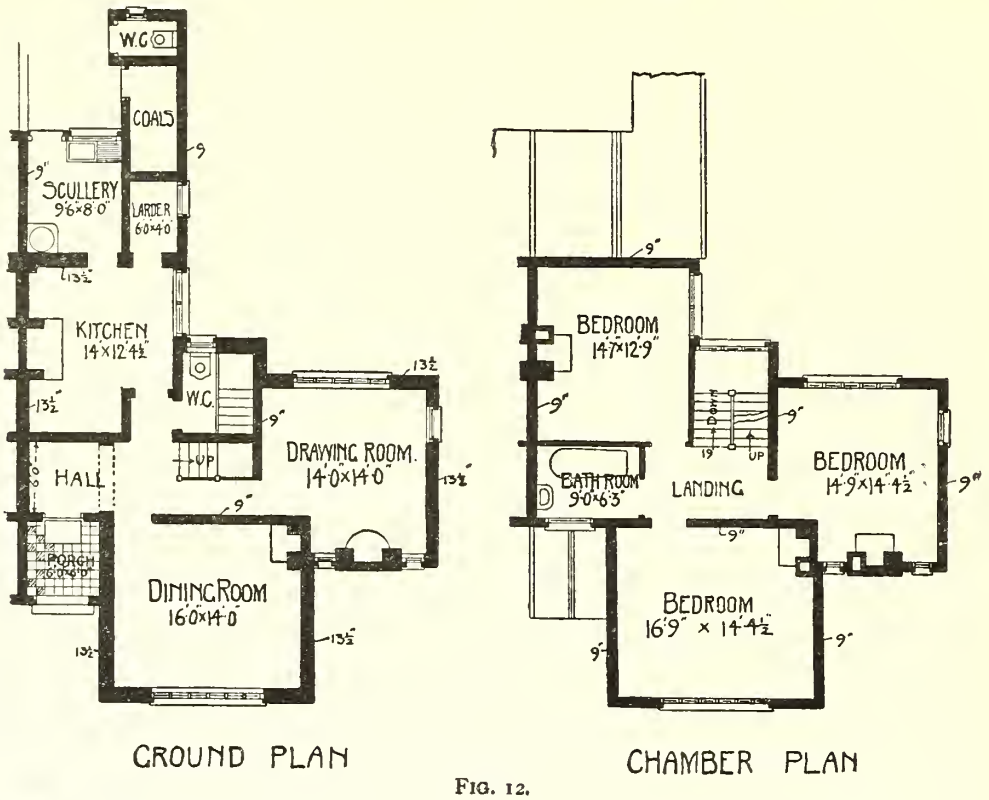


Fig. 12.

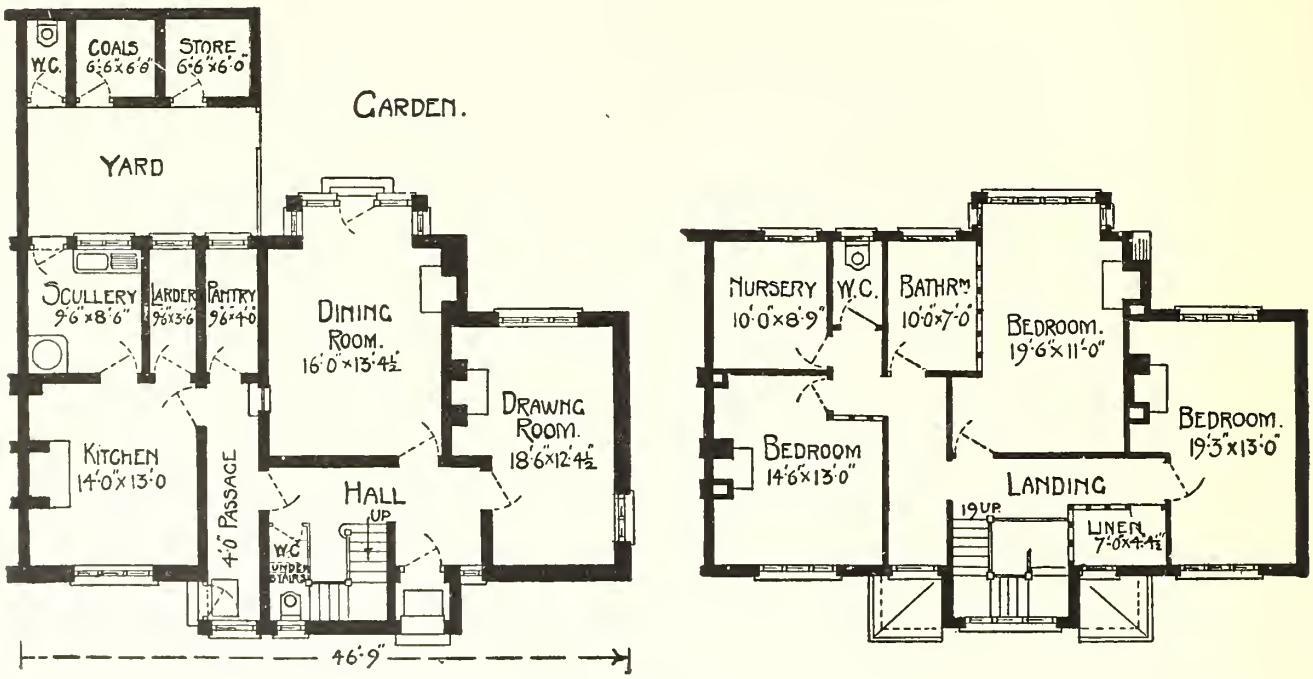


Fig. 13.

range and the outer wall with great gain of roominess and comfort and a saving of cost. The kitchen is too narrow, and there is no structural or economic reason why its outside wall should not be flush with that of the dining-room. The scullery, on the other hand, is rather large, and if it were simultaneously narrowed, rearrangement could be effected, enabling the larder, coals, and servants' w.c. to be reached under cover from the kitchen. All this is shown on an alternative ground plan.

An improvement upon this scheme is shown in Fig. 12, which is, however, a much smaller house, supposed to be planned for a southern, or at least a sunny, aspect to the front. The two porches are placed next to one another, and so are the two kitchens and sculleries, so that the living rooms of the one house are well separated from those of the other. The dining-rooms are in the front, so as to enjoy the full advantage of the sunlight, and the drawing-rooms at the extreme ends. The staircase rises between the drawing-room and the kitchen for the sake of light, and the result is a prettily grouped house, which, though very small, would be in all respects comfortable, the fullest advantage possible being taken of all opportunities for appearance.

A house with similar accommodation is shown in Fig. 13, but in this case it is supposed that the south is at the back, and consequently the staircases are kept to the front, the drawing-rooms at the extreme ends, and the dining-rooms close to the kitchens at the back, the plan being somewhat irregular to secure the maximum of sunlight in the principal rooms.

It is perhaps unnecessary to describe these plans in further detail, as they explain themselves, and the considerations which have governed house planning hitherto apply equally well to detailed arrangements in these as in previous cases. These may, however, be summed up by saying that there should be plenty of light to all parts ; ample means of ventilation without draught ; fireplaces, doors, and windows so arranged as to get the maximum of comfort, and to allow the furniture being satisfactorily placed in the rooms ; and that the whole should be grouped in such a way as to be easily and economically constructed, and the house worked with as little labour as possible.

Thus in the dining-rooms, in both Fig. 12 and Fig. 13, the fireplaces are placed in the corner, not to inconvenience diners at the table ; while comfortable fireplace recesses are arranged in both drawing-rooms. The chimneys from these fireplaces could be run together into a single stack, economising brickwork and warming the house, and in each room persons seated round the fire would have light for reading—especially if, in Fig. 12, another small window were opened near the dining-room fireplace. In Fig. 13 there is, too, the additional convenience of a kitchen entrance in the front, so placed that it cannot be mistaken for the principal entrance, and shutting off all scent of the kitchen from the rest of the house, while service to the dining-room is obtained through a hatch—an arrangement which necessitates two servants being employed. This leads, on the first floor, to a natural separation of the servants and nursery quarters, such as would be particularly useful in case of sickness. It is the larger and more expensive house of the two.

CHAPTER IV

WORKMEN'S DWELLINGS AND SMALL FLATS

The difficulty of providing satisfactory houses for the working classes in large cities, where the value of ground is considerable, at a rental within the workman's means, has led to the development of a distinct class of buildings, or one may say two distinct classes of buildings, which may be called "workmen's dwellings" and "workmen's flats." Of these the "dwellings" are based on the principle of crowding as many inhabitants upon a given space as possible, in barrack-like structures of great height and extreme simplicity, built in long straight rows with wide passages between them. Such is illustrated in Fig. 14. It will be seen at once that the cost of construction is considerable, as, owing to the great height of the building, the walls have to be extremely thick, and consequently a great deal of money has to be spent upon brickwork.

The blocks are divided up at regular intervals by party walls, and between the party walls two suites of apartments, if they can be so called, are arranged on each floor, served by a common staircase open to the front and protected only by an iron grating. In the particular example illustrated the level of the ground was considerably lower than that of the street, and consequently it was necessary to go down stairs from the street to the ground floor, the front windows of which had their sills almost level with the pavement. On this floor a passage passes through to a yard at the back, which is open for common use by all the inhabitants of the dwellings. In this passage the dust discharges, being received from a shoot from all the floors, and is caught by a large receptacle. One cannot help thinking that it would be much better if small dustbins were used, one to each set of apartments, for this could in no case be a very savoury arrangement.

The accommodation is extremely limited. On the ground floor each habitation consists of two rooms only, together with a separate w.c., and with the addition of a small larder in one case underneath the stairs. There is no possibility of introducing a copper, and the sink is placed in the kitchen. On the upper floors one of the dwellings consists of three rooms and the other of two, except on the top floor, where each consist of a single room only, half the space being given up to an open drying yard or flat of concrete. There is no attempt at comfort in planning, and every other consideration has to give way to providing as many residences on the site as possible, in order to secure the maximum of rental; and it is astonishing what high rents these little dwellings produce. They lead, of course, to overcrowding and all its attendant evils, while the life of anyone who is condemned to spend the whole day in one of the upper floors of dwellings such as this must be dreary in the extreme. Fortunately, in spite of the high rents charged, it has been impossible to make workmen's dwellings of this kind produce a sufficient return for the capital invested, and they are now very rarely built.

A much better plan is that of providing two- or at most three-storey flats in accessible suburbs with a small garden at both back and front for each flat if possible. In the suburbs selected the ground is moderately cheap, so that its cost does not weigh so largely in the financial scheme as to render these buildings unprofitable.

In Plate I. will be found an illustration of a series of such flats which it was proposed a few years since to erect on a hilly site overlooking Southampton Water. Most of the houses, namely, Nos. 3–41, were planned as shown on the left-hand side. The ground and first floors were alike, the upper one being reached by an external staircase, and each residence consisted of three rooms sufficiently large for moderate comfort. The sink was placed outside the kitchen, and just beneath a small window, this being the best thing that can be done where there is no separate scullery. There are bay windows to the front, and the kitchen opens at the back into a small yard or garden. Every residence has its own separate entrance in the form of a small hall, so devised as to waste but little space. The first floor residences have their back garden or yards reached by a bridge, this being rendered possible by the slope of the ground.

Of course, these residences are exceedingly small, and there is not so much bedroom accommodation as one would like. It is generally advised that no family residence should contain less than three bedrooms, but there are many circumstances under which fewer rooms will suffice, and these comparatively low-rented flats for the working class are necessarily devised with extreme economy. With that end in view the chimneys have been kept together, and the result has been rather advantageous than otherwise to the rooms, which are rectangular.

At one portion of the site there was an awkward piece of ground, and advantage of this was taken to provide rather larger residences (Nos. 1 and 2), the

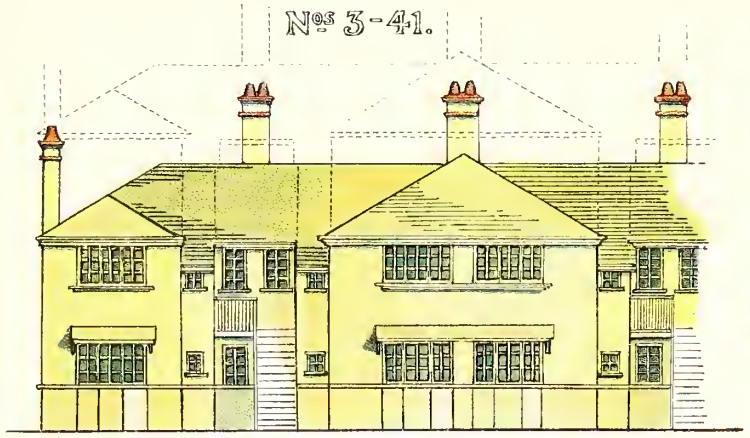
Simnel St and Castle Lane Site.

Proposed Tenements.

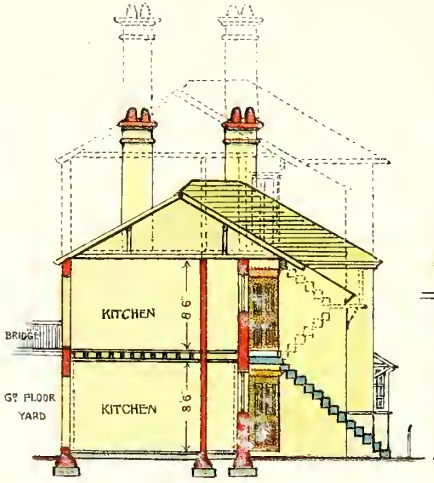
Plate I.

Detail of Houses.

Nos 3-41.



Elevation to Road

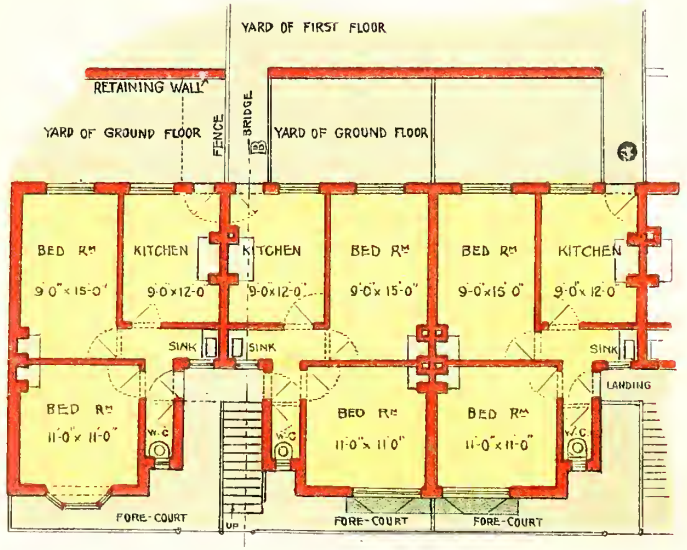


Section, A.B.

Second floor shewn by dotted lines

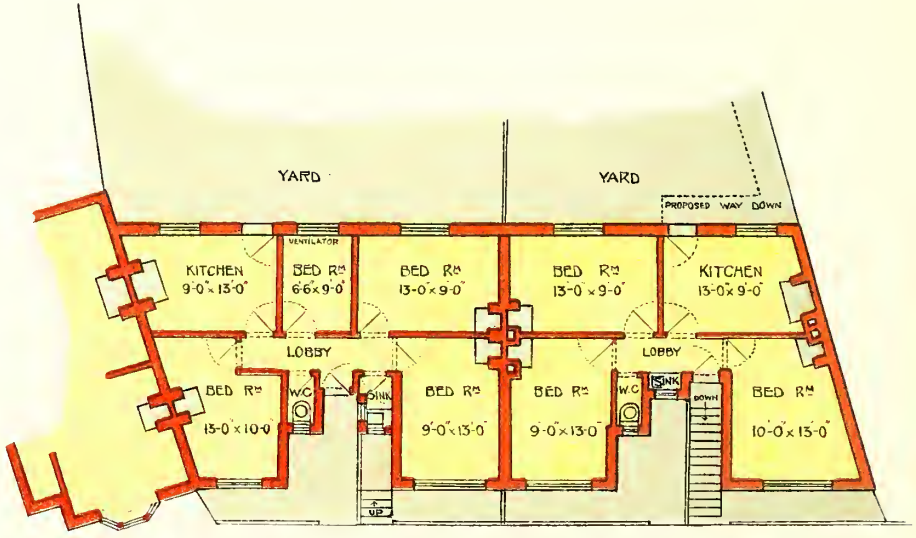
Nos 1-2.

Elevation to Road



Ground Floor Plan

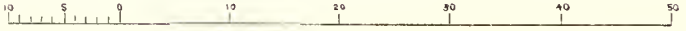
First Floor Plan.

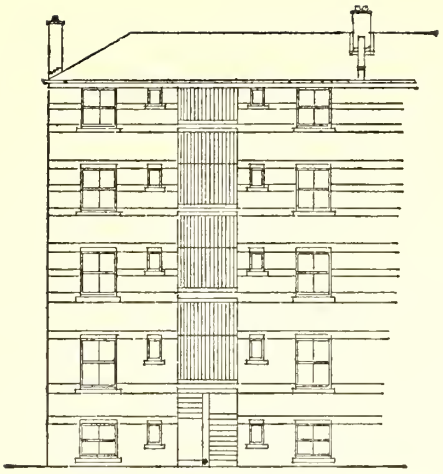


Ground Floor Plan.

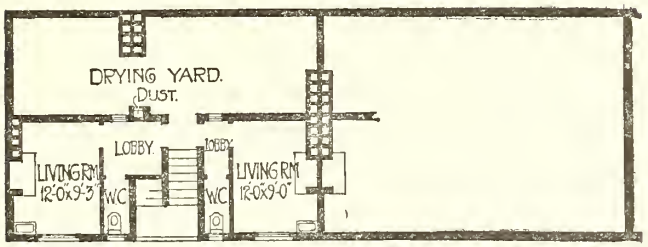
First Floor Plan.

Scale of Feet.

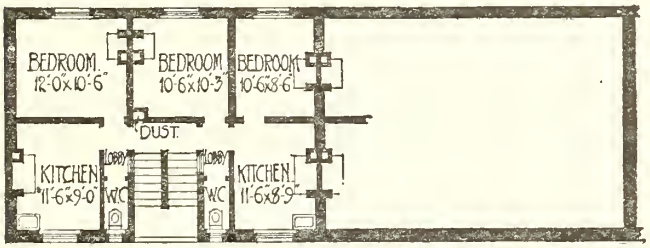




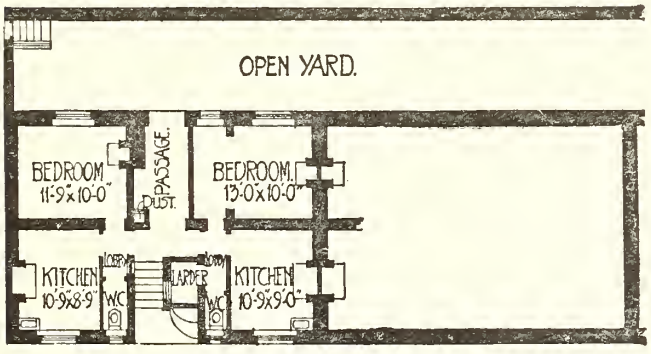
FRONT ELEVATION.



PLAN OF 4TH FLOOR.



PLAN OF 1ST 2ND & 3RD FLOORS.



PLAN OF GROUND FLOOR.

WORKMENS DWELLINGS, MERMAID COURT. SE.

FIG. 14.

corner house having three bedrooms on each floor, and the other one having four, with the sinks in recesses as before, and thus out of the way of direct passage from room to room, and well lighted. The elevation has been kept as simple as possible, but by the use of rough-cast a sufficiently pleasing effect has been obtained to render the tenements homelike in appearance, and to give an external impression of comfort, which is itself by no means a small thing.

Fig. 15 illustrates a scheme by which the staircase to the upper floor is kept under cover. The entrances to both ground and first-floor houses occur under a sheltered porch, and the living room of the ground-floor house is entered directly from the exterior. This is a comparatively large room with a cosy bay window, and would be a comfortable room to live in, although it contains the sink. Out of this a cross lobby is reached which serves three bedrooms, two of which have corner fireplaces and are small. These are placed at the back, while the third room is comparatively large, with a bay window similar to that of the kitchen. There is a small store under the stairs, which would serve for fuel, and a separate larder is provided beside the passage to the back yard or garden. The first-floor residence is as nearly similar as is possible, the larder now being obtained as a cupboard out of the kitchen. Over the bottom portion of the staircase there is a second staircase of iron leading down from the back door of the first-floor residence to the garden behind that belonging to the lower flat, and the space beneath it is utilised for the w.c. to the lower flat.

The only objection which can well be raised to these flats is that they occupy a good deal of frontage, otherwise they provide sufficient accommodation for a family of moderate size under the conditions usually found amongst the working classes.

It will be noticed that no copper is shown on any of these plans. If washing has to be done at home it would have to take place in the kitchen, which is also the general living room, and this would be exceedingly uncomfortable. It is generally thought better in flats of this sort to force the inhabitants to do their washing at a public wash-house, as tending to greater comfort in the home; and as both the dwellings and the wash-houses are usually built by the municipality rather than by private enterprise, there is no objection to this course.

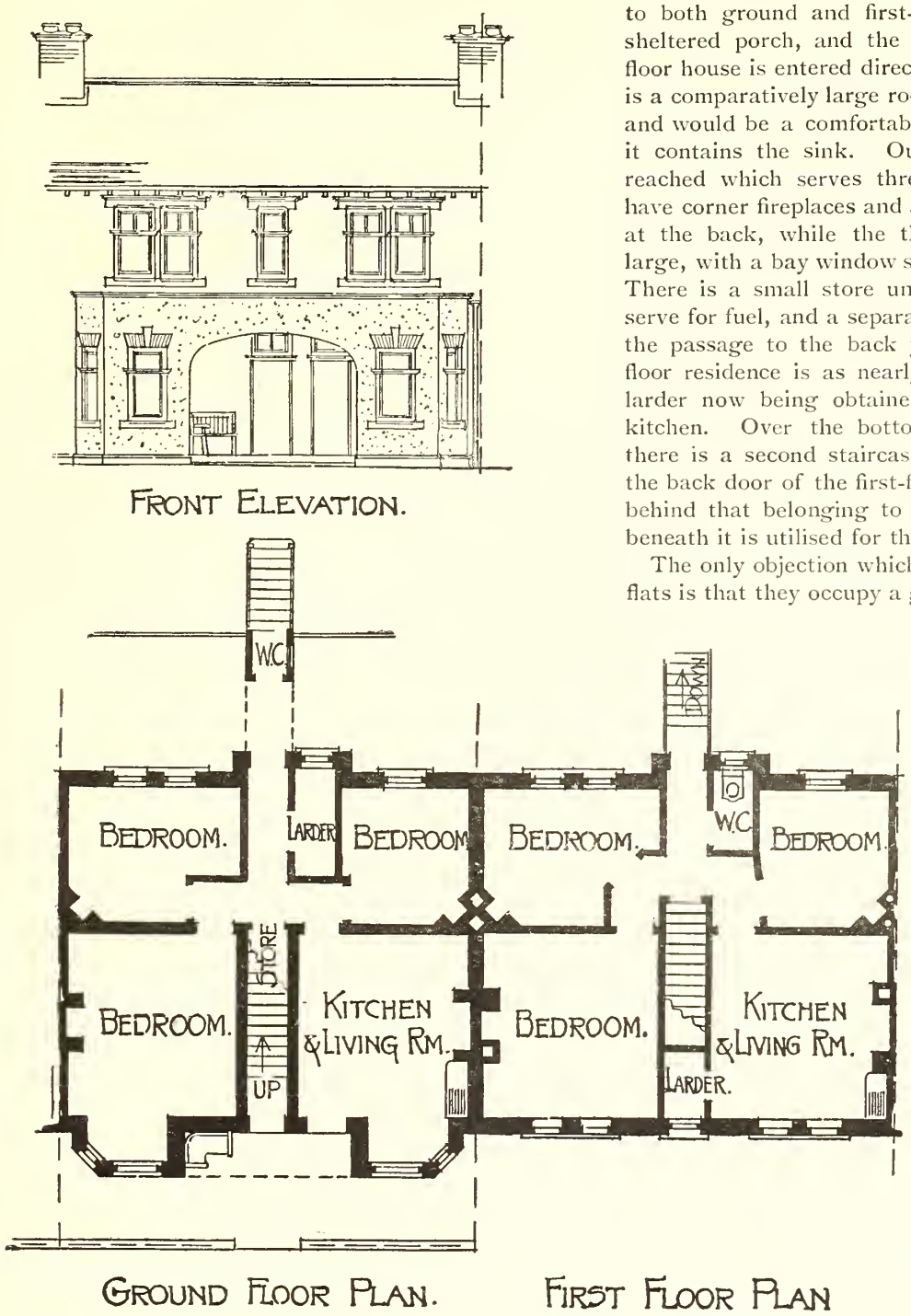


FIG. 15.

CHAPTER V

MIDDLE-CLASS FLATS

It is only in comparatively recent times that it has become common in England to provide town dwellings for the middle classes in the form of flats; but now comparatively few separate houses are built, and flat dwelling is customary. The principal reason for this is to be found in the economy of service which is effected, there being fewer servants required for a family living in a flat than for one living in a house, together with the convenience of being able to shut up one's residence and go away at any moment by merely locking the door. Of course, it is rarely possible for a person to own the freehold of a single flat, although this was done in some cases a hundred years ago; but in large towns few persons own their own houses, and the sentimental objection to sharing a house with other people is by no means so strongly felt as it is in the country.

Upon the comparative advantages of flat and house living there is a good deal to be said on both sides, but this is hardly the place to enter into the matter. The general difficulties of flat planning are considerable, and different from those to be met with in ordinary house planning. It is necessary to provide accommodation for an entire family upon a single floor without, as a rule, having a large area of ground at disposal. Frequently economics of space are necessary which are rather suggestive of a ship's cabin than of a dwelling-house, yet it is possible with care to produce comfortable and even cosy dwellings, well lighted and cheerful. This, however, can only be done by the exercise of ingenuity, and the majority of the smaller flats, or maisonettes, as they are frequently called, are unsatisfactory upon almost all grounds. Fig. 16, for instance, illustrates a type of plan which has been followed largely in South London. The primary object here has been to crowd as many flats as possible on to a small frontage, and every possible advantage has been taken of the provisions of the London Building Act, which considers a series of dwellings whose party walls are not more than 40 feet from centre to centre, and are served by a common staircase, to be a single house. Thus each 40 foot frontage has an entrance hall and staircase in the middle, which is common to the inhabitants of all the flats, of which it serves two upon each floor, separated from one another by a long party wall. Each flat has therefore a frontage of only 20 feet, which allows of but one room being placed in the front and one at the back, except by extending in the form of a back addition. This is done as a matter of course with the result that the space between the

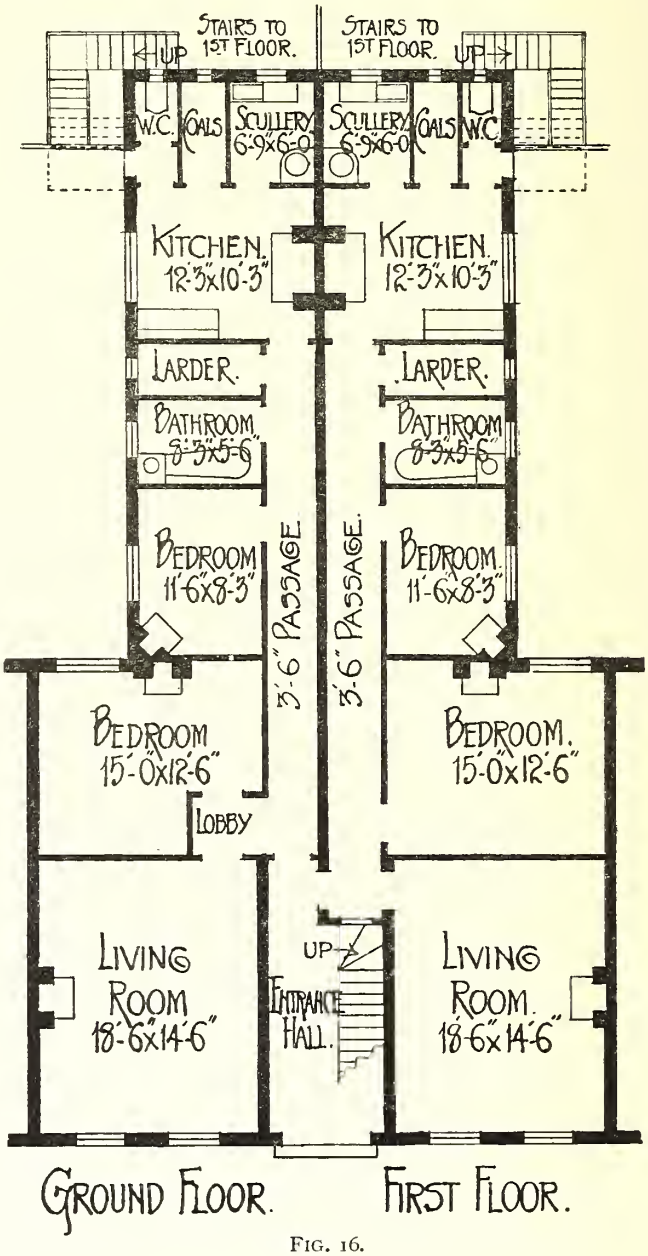


Fig. 16.

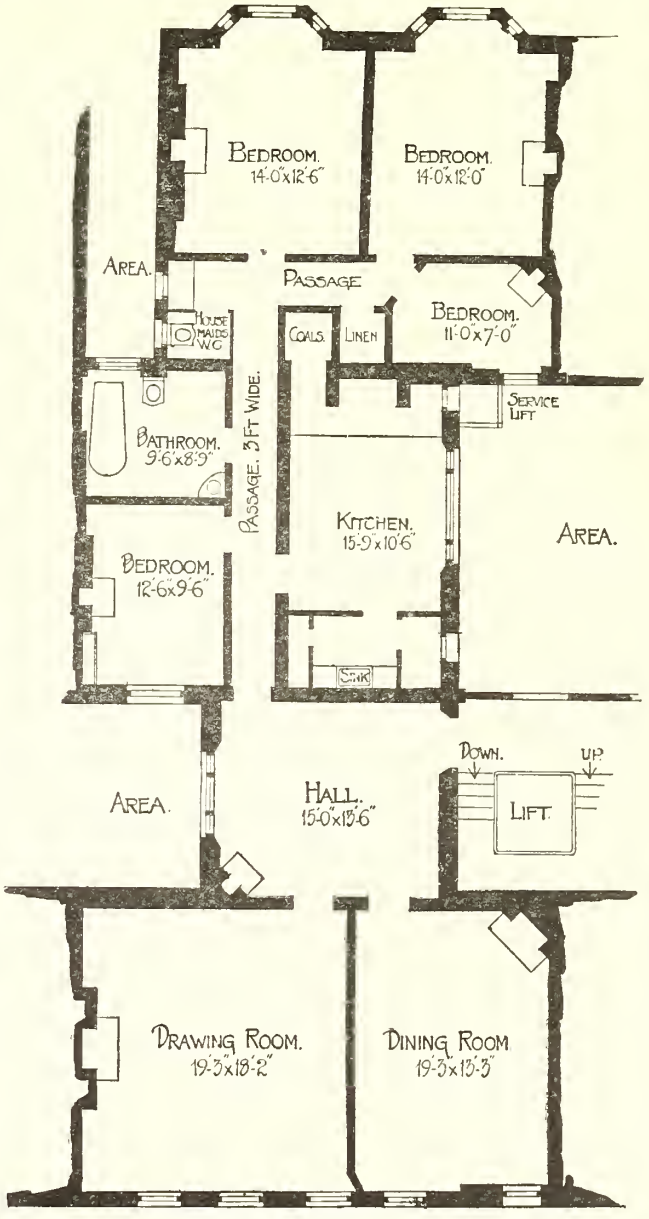
long back additions is itself long and narrow, and the rooms extremely small, the passage being almost

without light or ventilation. The living room is in the front, with the largest bedroom immediately behind it —and that is not very large. It is followed by another small bedroom whose window looks directly into the window of the similar room in the next back addition. Beyond that are found a bathroom and larder, and then the kitchen, out of which open, at the back, the scullery and small coal store, with a way out to a garden, either direct or down a flight of iron stairs which serve as an emergency exit from the upper floor in case of fire. The narrow yard or space between the back additions forms the garden of the ground-floor suite, while any yard at the back is appropriated by the people who live on the first floor. Usually these flats are only of two storeys, but often they are higher, when the long narrow space between the back additions is even more objectionable. It is into this space that both the bedrooms and the kitchen have their outlook, directly facing similar rooms in the neighbouring tenement, with scarcely the possibility of direct sunlight. The living room in front is, in fact, the only one which is well lighted, and it is usually spoilt by careless placing of the door, window, and fireplace. This type of plan is illustrated rather because it is in common use than in order to recommend it.

All the internal walls may very well be formed of one of the modern patent thin partitions in order to economise space. The spans are not great, and ordinary floor joists can easily be carried, though it is more usual to introduce some simple form of fire-resisting floor.

Little flats of this sort can be worked without servants, and although the rents are somewhat high, economy is effected by living in them. This is perhaps the general reason for their being so largely built as they are at present.

When the primary object is not extreme economy it is, however, possible to produce comfortable and satisfactory dwellings on the flat system. Such is the flat, No. 9 Russell Mansions, in Southampton Row, Bloomsbury, illustrated in Fig. 17, which shows the plan of one of the upper floors. The lift occupies the staircase well, as is usual in English work, and is reached by a passage on the ground floor from the street, and passes from that level up to the top of the house, the basement being occupied by a similar house to the others, occupied by the caretaker, who manages the lift and looks after the coals, for which there are separate cellars for each flat. The lift is large enough to accommodate passengers and luggage, and at each floor comes to rest upon a landing out of which open what may be called the front doors of a pair of flats. These lead into a large hall, which can be furnished as a sitting-room if desired, although out of it two large rooms open in the front as drawing-room and dining-room respectively. The hall is lighted from an area, while a larger area serves to light the staircase and lift. A passage passes from the hall towards the back, leading to a large kitchen with a scullery attached to it and a small coal store on one side, and to a servant's bedroom and a bathroom on the other; and, being continued, provides means of access to three more bedrooms in the rear, two of which have bay windows and a pleasant outlook over



Nº 9 RUSSELL MANSIONS

FIG. 17.

some gardens, while the third is a mere small, supplementary room lighted from the main area. A good deal of thought has been expended upon the details, with the result that it is really a comfortable house on a single floor, suited to a family of moderate size, and capable of being worked by a single servant. Were the same accommodation provided in a detached

house it is certain that from two to three servants would have to be kept.

One of the principal objections to flats is that the smell of the cooking permeates the whole of the house, but this is here well provided against by the construction of large halls between the sitting-rooms and the kitchens. It will be seen that it is very difficult to provide pleasant recesses in the rooms such as ingle nooks, but at least it has been possible to arrange the dining-room fireplace in the corner, and the hall above them. This is an economy of space which is now frequently adopted, the shops being here shown as mere open spaces on the ground floor with stairs down to basement storerooms, and have to be locked up when left of a night. Each of those shown has a small office attached to it at the back, and those near the centre have a long narrow storeroom on the ground floor behind the general staircase, which leads up to the flats. This is in the centre of the block at the front, and the lift passes up a staircase well, as is

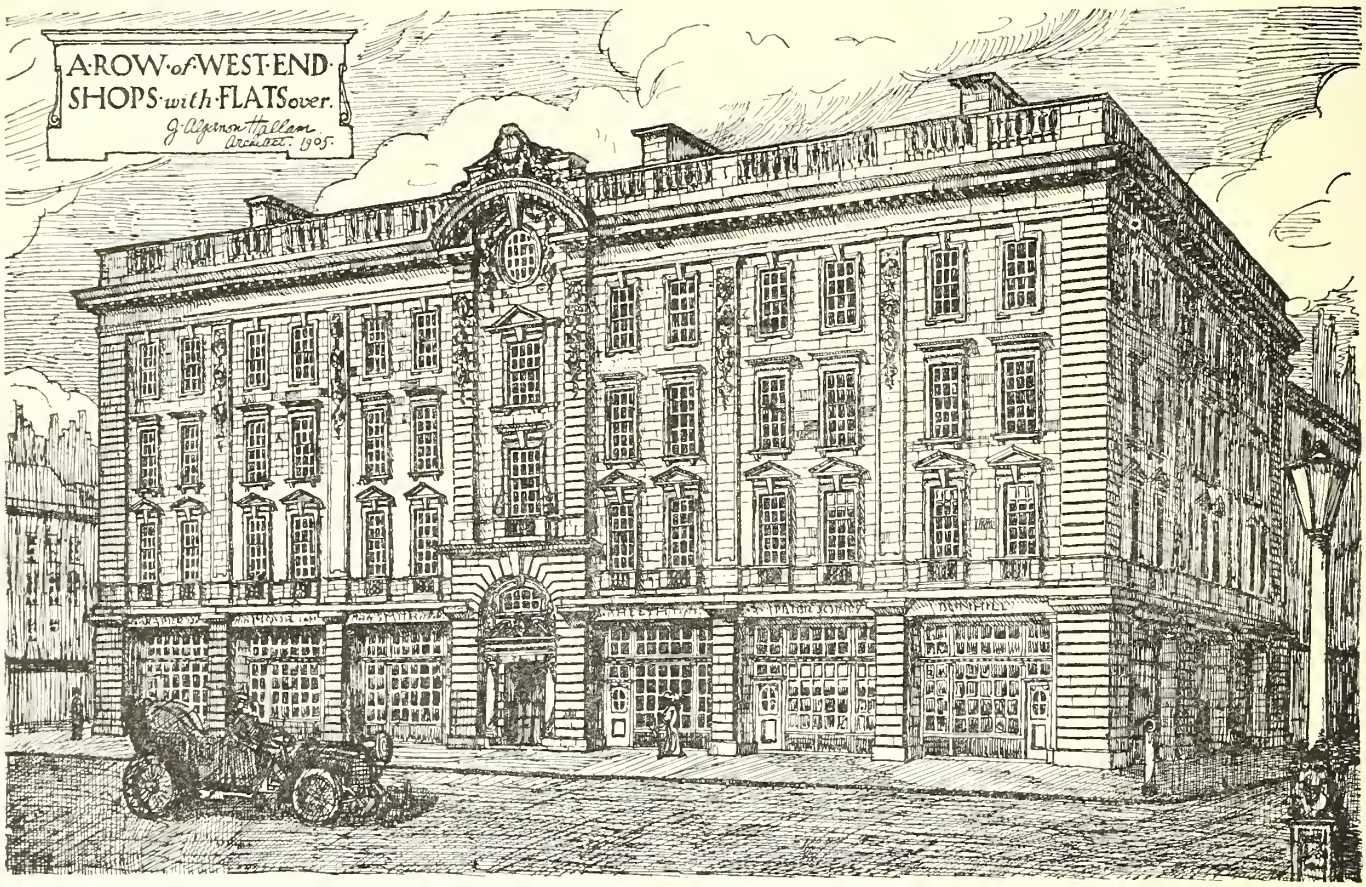


Fig. 18.

fireplace also, while the rooms are large enough for the avoidance of draught.

The plan is not an entirely modern one, and under the present London Building Act the service lift would have to be replaced by a subsidiary staircase for use in case of fire. Since it was designed, too, the idea of planning flats on narrow frontages such as are suitable for houses has been to a large extent abandoned, for it almost necessarily leads, as in this case, to the use of well-like areas, providing but indifferent light and ventilation to the rooms whose windows open on to them.

Fig. 18 illustrates a row of shops designed by Mr. J. A. Hallam for the west end of London, with flats usual, though the architectural effect is forcibly marred thereby.

The plan of the upper floor is somewhat interesting, though considerable use of girders has been made to carry the internal walls. It covers a considerable amount of space, but there are no enclosed areas, and all the principal rooms have windows upon a street frontage. There is a long passage to serve the various rooms, but it is well lighted by a bow window, and the flat is well departmented, a kitchen, scullery, and larder, with a coal bunk opening out of the kitchen, being quite self-contained, there being only one communicating door, which is almost opposite that of the dining-room, disconnection being obtained by the introduction of a

small servery. The servants' w.c. is reached by way of a small open balcony, large enough for the movable dust receptacle. All the w.c.'s are at the back, while a gentlemen's lavatory is provided, opening out of the hall, much as is usual in large private houses. The dining-room and drawing-room open out of the main corridor; but this, the reception part of the house, is detached from that part which is used for bedrooms by swing doors leading into another corridor, itself well lighted. There are four bedrooms, and also a large dressing-room which could be used as

ments of particular sites. There is accordingly more scope for ingenuity in planning than there is in the detached or semi-detached house, especially if small areas and narrow unventilated spaces are to be avoided, and economy of space obtained at the same time as considerable luxury of living, and architectural treatment of stairs and approaches as well as of the principal rooms of each tenement.

With these may very well be contrasted a typical New York apartmental hotel, as it is called, such as is illustrated in Fig. 19, this being the plan of one of

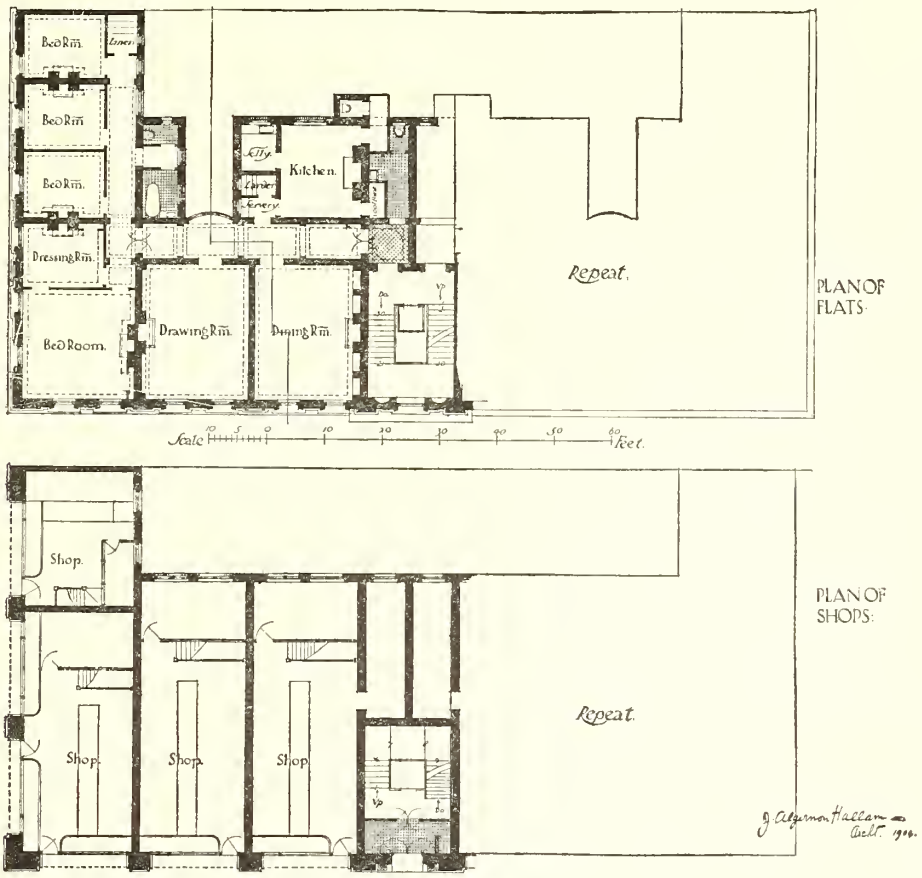


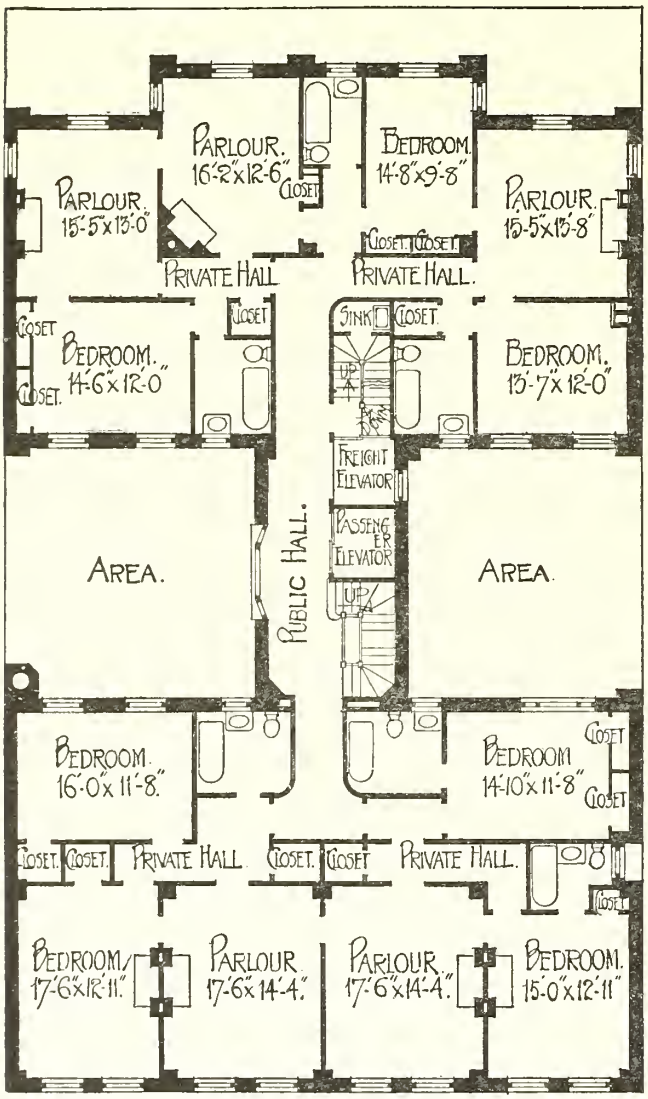
FIG. 18A.

an additional bedroom if required, together with a linen cupboard and bathroom, so that the total accommodation is not different from that found in many a detached house. All the rooms and corridors are well lighted, and although naturally it has been impossible to consider the question of either prospect or of aspect, save so far as to place the kitchen in the rear and the principal sitting-rooms in the front, a certain amount of architectural treatment has been secured internally, both in the corridor and in the rectangular and symmetrically planned rooms.

Figs. 17 and 18A may thus be taken as illustrating two distinct types of London flats, of which the variety is necessarily great, owing to the particular require-

the floors of a well known "Sky-scraper." It will be seen that the public hall and staircase are in the middle of the site, there being two elevators or lifts, one for passengers and one for freight, passing up from bottom to top of the building. There is also a small service staircase close to the freight elevator, having a sink in a dark cupboard on each landing. The drawing needs a little careful consideration in order to observe how it is meant to work the various flats; but this is a case in which each residence is not self-contained, it being intended that the various persons who occupy suites of rooms shall rent them for parlour and bedroom use, while they take their meals in the general dining-rooms of the hotel. There are thus no

private servants, all service being provided by the management, and consequently there are no separate kitchens to the several flats, which are capable of being let off in suites of two, three or more rooms as desired, there being communicating doors between the various rooms, which have to be locked in the event of the adjoining apartments being let to different



APARTMENT HOTEL, NEW YORK.
MESSRS. ISRAELS & HARDER, ARCHITECTS, NEW YORK.

FIG. 19.

persons. A large number of bathrooms are consequently provided, it being apparently supposed that as a general rule a suite shall consist of a parlour and either one or two bedrooms at the most, together with a dark and unventilated cupboard, sometimes opening from the private hall, and frequently from the bedroom, where in America they take the place of the English wardrobe. The w.c. is in every case shown in the bathroom, an arrangement which has nothing save economy of space to recommend it. Fireplaces are not shown in all the rooms, nor would they be necessary, for the heating would as a rule be accomplished by means of hot water or steam radiators, the circular flue from the heating apparatus being shown in one corner. The public hall is well lighted, and so are the rooms generally, but the little private hall to each separate flat would be dark, and in some cases tortuous. Darkness, however, would probably be little objected to where electric light is plentiful, but unfortunately it is generally combined with insufficient ventilation, and the English well-lighted hall and passages would be preferable.

Marlborough Chambers, Jermyn Street, designed by Mr. Reginald Morphew, and illustrated in Fig. 20 and Plate II., show a somewhat similar scheme of living as adapted to English needs. The ground floor has, for the sake of the rents obtainable on this very valuable site, been devoted to lock-up shops with storerooms in their basements, some of these having large showrooms extending in the rear and top lighted, while the corner shop possesses private offices. There are two entrances, that in Jermyn Street being the principal, and leading to a large hall which contains the porter's office and passenger's lift. A corridor passes down, lighted from an area, to a second hall containing another staircase and lift which serve a different section of dwellings, while providing the emergency exit in case of fire demanded in London. This second hall can also be reached from the side entrance in Bury Street, which is intended more for the use of servants than for the inhabitants of the flats. As in the American apartmental hotel, it is intended that all the cooking shall be done in a common kitchen, and the flats served by a staff of servants kept by the management; but there is no general dining-room, and in each suite of flats there is sufficient sitting-room accommodation for the meals to be taken in privacy. These flats are not intended for family residence, but to be used as bachelor's chambers, so that most of them are provided with only one sitting-room and one bedroom, together with a bathroom, though some larger ones have additional bedrooms, so that they could be shared by two or three young men, and also a smoking-room. A great deal of trouble has been taken to make the flats comfortable. Thus in suite No. 1 there are recesses both in sitting-room and bedroom, and there is means of access from the sitting-room to an open balcony, while suite No. 2 contains a large number of cupboards. It will be noticed that the directness of planning which has been so observable in Figs. 18 and 19 is here replaced by a number of clever little devices to secure comfort in the various rooms, a great deal of use being made of bow windows and balconies. Every room is provided with its own fireplace, but the chimneys have been carefully grouped both for the sake of economy and to secure satisfactory effect in the

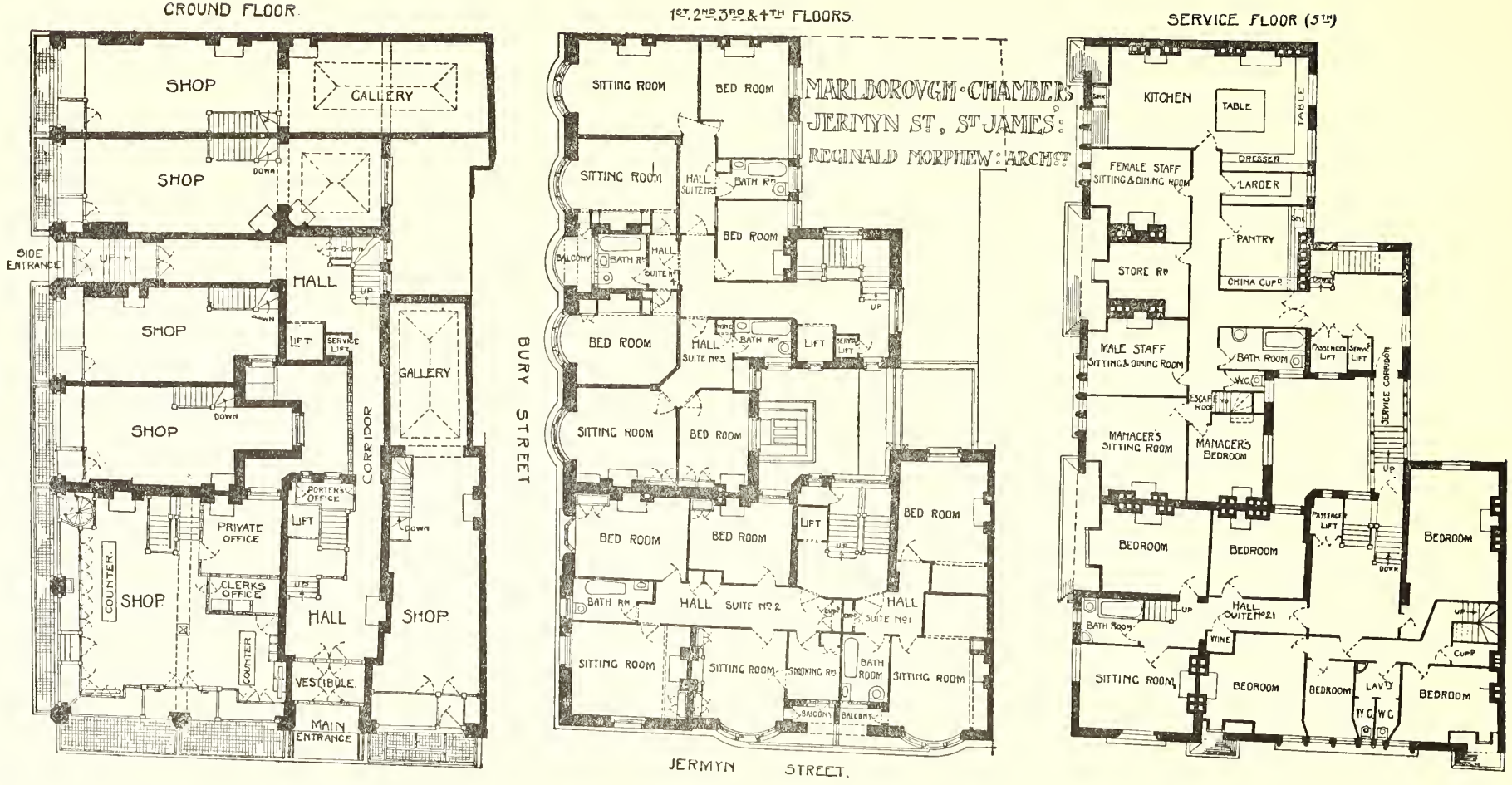

GROUND FLOOR
SHOP
GALLERY
SHOP
SIDE ENTRANCE
HALL
SHOP
LIFT
SERVICE LIFT
GALLERY
SHOP
CORRIDOR
PORTERS OFFICE
PRIVATE OFFICE
LIFT
COUNTER
SHOP
CLERKS OFFICE
HALL
SHOP
COUNTER
VESTIBULE
MAIN ENTRANCE
BURY STREET
1ST 2ND 3RD & 4TH FLOORS
MARLBOROUGH CHAMBERS
JERMYN ST. ST JAMES'S
REGINALD MORPHEW: ARCHT
SITTING ROOM
BED ROOM
SITTING ROOM
HALL
BATH RM
BED ROOM
BALCONY
BATH RM
HALL
BED ROOM
HALL
BATH RM
LIFT
SERVICE LIFT
SITTING ROOM
BED ROOM
BED ROOM
BED ROOM
LIFT
BED ROOM
BATH RM
HALL SUITE No 2
HALL SUITE No 1
SITTING ROOM
SITTING ROOM
SMOKING RM
BATH ROOM
SITTING ROOM
BALCONY
BALCONY
JERMYN STREET
SERVICE FLOOR (5TH)
KITCHEN
TABLE
SINK
TABLE
DRESSER
FEMALE STAFF SITTING & DINING ROOM
LARDER
PANTRY
STORE RM
CHINA CUPB
MALE STAFF SITTING & DINING ROOM
BATH ROOM
PASSENGER LIFT
SERVICE LIFT
W.C.
ESCAPE
SERVICE CORRIDOR
MANAGER'S SITTING ROOM
MANAGER'S BEDROOM
BEDROOM
BEDROOM
PASSENGER LIFT
BEDROOM
BATH ROOM
HALL SUITE No 1
WINE
CUPB
SITTING ROOM
BEDROOM
BEDROOM
LAVTY
W.C.
W.C.
BEDROOM

Fig. 20.

elevation. As in the case of the American plan, it would be quite possible to rearrange the suites without any great amount of trouble by closing existing doors or opening others, but this would have to be done by actual structural alteration, not by merely locking a door which has been provided.

Perhaps the most interesting plan is that of the top floor, which contains the kitchen and the staff bedrooms. To these it has been found impossible to give quite sufficient accommodation, although the kitchen is certainly large; but the two staff dining-rooms for men and women servants respectively are hardly sufficient, considering how many persons would have to occupy them. The lifts have been carried right up to this floor from the bottom, and the manager has his apartments so placed as easily to control the staff, while being within access of the various residents when necessary. The Jermyn Street frontage, even on this top floor, has been reserved for a suite of flats, thus reducing the number of staff bedrooms; though one would hardly think that enough rooms had been provided to meet the requirements, and as a matter of fact it has been found necessary for many of the servants to live out, particularly the private valets of the various residents.

Of late years the tendency of English flat planning has been towards the avoidance of enclosed areas, such as those shown in Figs. 17 and 19, and of the long back additions, with the long and narrow spaces between them exhibited in Fig. 16, and the substitution of plans in which the rooms all obtain their light from the main streets, while the back is given up to corridors and kitchens, as in Fig. 18A. This is not economical in frontage, but produces a more healthy building, and a more obviously cheerful one—a very great consideration in attracting tenants.

Flats are essentially residences which are built to let, and not to be used for the habitation of their owners. Personal likings consequently have not to be considered, and eccentricities, and even unusual conveniences, which are permissible and often imperative in private residences, have to be avoided, and that provided which is more likely to be generally acceptable. The impression of spaciousness and luxury should be given by means of a good approach and well-lighted passages of ample width. Little conveniences, such as the provision of permanent washstands in the bedrooms, with hot and cold supply, are greatly appreciated, as also is cupboard room—often obtainable at a high level without encumbering the floor space; for all these things go to reduce the amount of movable furniture necessary, and enable the payment of rent to save the necessity for capital outlay, it being remembered that a migratory class is being catered for which can afford to pay in small instalments rather than in bulk.

CHAPTER VI

OFFICES AND SHOPS

THERE is a certain similarity between the planning of offices and the planning of flats when the offices are upon a large city scale, arranged in suites served by a common lift and staircase. The principal difference consists in the fact that there are less classes of rooms to provide for. A small suite consists of little more than the principal's office with a room for clerks opening out of it, and possibly a small telephone and typist's room, but in many cases it is advisable that there should be means of extension so that three, four, or even five rooms may be let for a suite if desired, each one having a separate entrance from a well-lighted corridor. Every room needs to have ample window space and wall space. The rectangular form is much the best, without breaks, for the only furniture to be introduced consists of desks, tables, and shelves for books, etc.—any odd corners can be usefully given up to safes and strong-rooms. As in English flat building, so in modern offices, the lift generally occupies the well of the staircase, there being a small room or cupboard for the porter close to it on the ground floor, and close also to the entrance from the street. The difficulty of providing proper light to all parts is much the same as in all classes of city buildings, and has often to be overcome by the introduction of comparatively small areas, which serve to give side lights to staircases and corridors on the upper floors, and top light to some of the less necessary rooms on the ground floor or basement. Space is so valuable in a large town that the basements are almost always occupied either with storerooms or the housekeeper's premises.

A typical set of London offices is that in Cockspur Street recently erected from the designs of Mr. Henry Tanner, Junior, illustrated in Fig. 21. It is more than usually interesting from the irregularity of the site, and, as frequently happens, the whole ground floor is given up to one large office, which might serve for an insurance company, bank, or many other purposes, it being in this particular instance used as a shipping office. It will be noticed that a large public room of rectangular shape occupies the greater part of the space, with a large swinging and rotating door in the middle of the frontage. A large amount of counter room is provided, with as much space as possible in front for the general public, leaving three desks and a small office for clerks behind. A passage beside the counter on the left leads to a waiting-room, from which the private office of the manager is entered, the manager's room having doors also both into the front general office and into the clerks' office, so that everything is under perfect control. As there is a glazed partition shutting off these private offices from the general office in the front, the manager would be able to pass to the hall, and so into Cockspur Street, without being observed, and could also in this way pass out any visitors who did not wish to return through the waiting-room. Opening off this back passage there is a small room for a telephone, and three others for typists. These would all be constructed with sound-proof partitions, and would be top lighted from the areas shown on the second-floor plan. The writing-room, which is shown opening on the right out of the general shipping office, would in many cases not be necessary, and would be occupied then by an assistant manager or by clerks, but it is a useful adjunct in a place where travellers from many countries might wish to congregate. A private staircase leading down to basement strong-rooms is to be seen close to the typists' rooms. There is a side entrance from Cockspur Street into an architecturally treated hall, with lift and staircase rising to the upper floors, which are alike, varying only in small details to suit the elevations. There is a good landing on each floor with cupboards or strong-rooms opening out of it, while double doors lead to a side corridor from which all the offices are entered. As a general rule each floor would be let off as two suites, but in cases of necessity all could be thrown together by means of the communicating doors, or they could be let separately, except in the case of one small room, which is only to be entered through others. No particular effort has been made to render these rooms architecturally pleasing, the principal object evidently being to make them rectangular so far as possible, and to give each the maximum of light and of space, though in the matter of light those in the middle would not come very well off. It being impossible to tell when they are erected for what businesses these offices would have to serve, they cannot be planned with any definite object, but it is always well to provide long windows to such rooms as have a north light, so that if necessary a drawing board or drawing table can be placed at the window.

A somewhat unusual and clever variation of the common arrangement is shown in Fig. 22, which illustrates 38 College Green, Bristol, as rebuilt from the designs of Messrs. La Trobe & Weston. The site

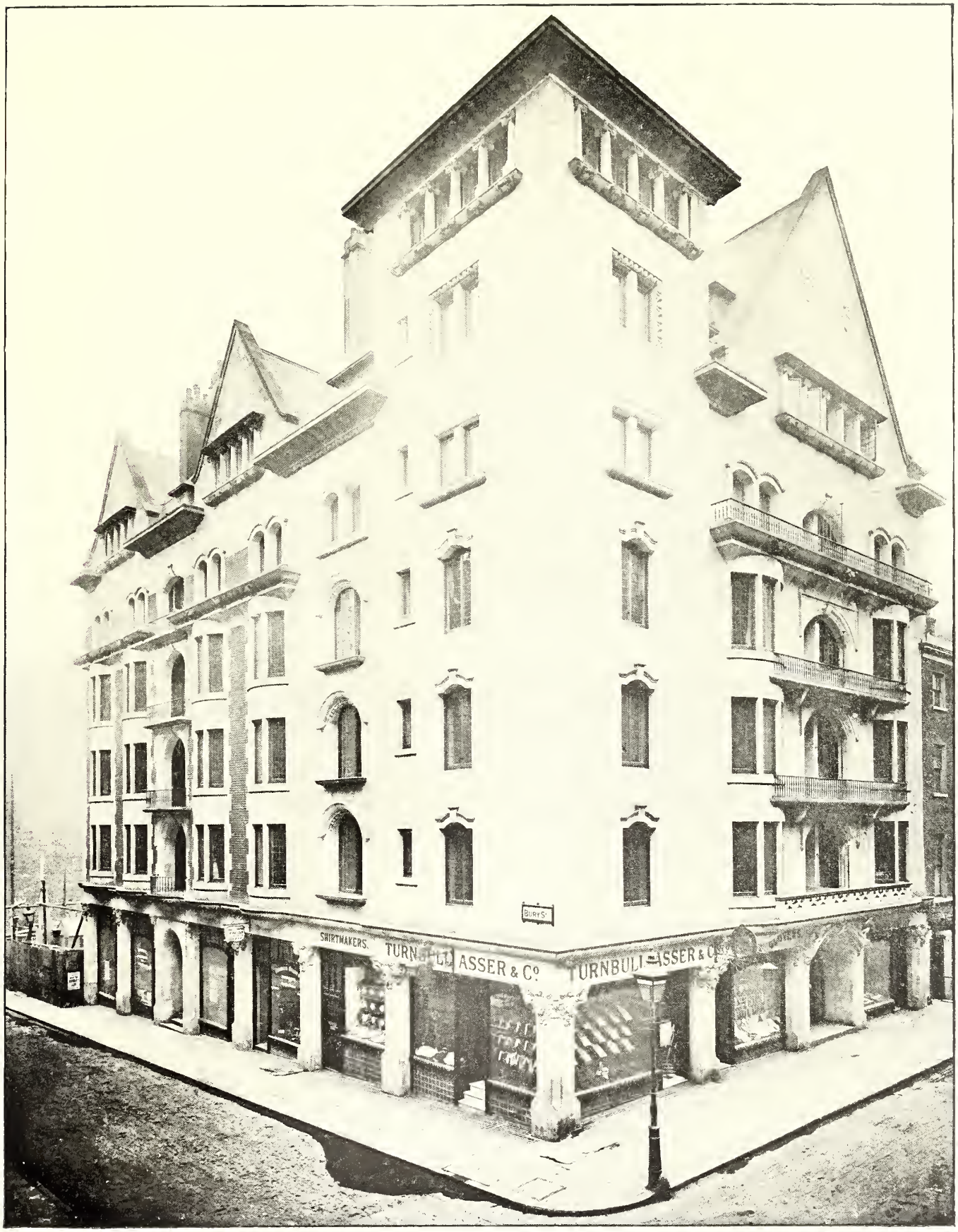
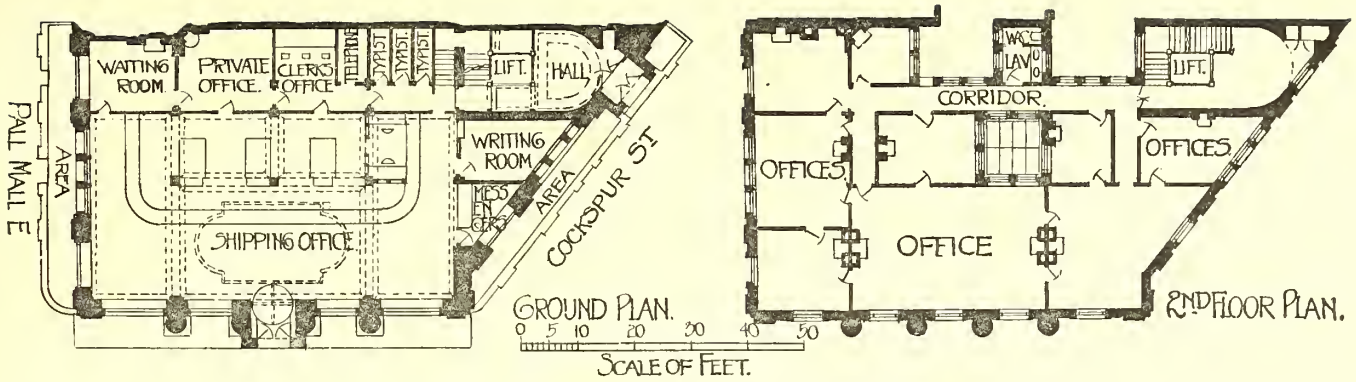
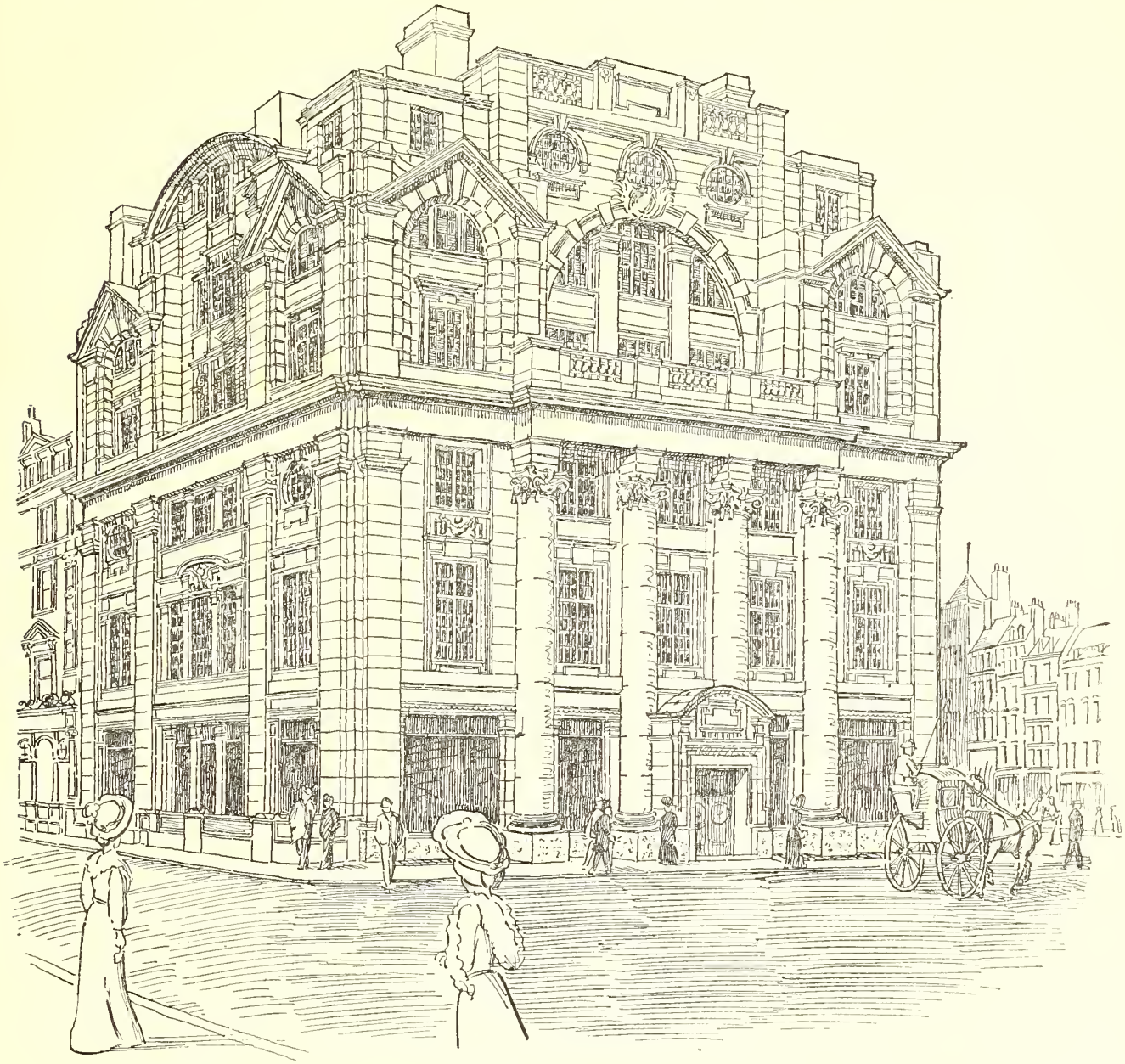


PLATE II.

MARLBOROUGH CHAMBERS, JERMYN STREET, W.

REGINALD MORPHEW, *Architect.*





NEW SHIPPING OFFICES, COCKSPUR ST.

H. TANNER JUN.R, ARCHITECT

FIG. 21.

was narrow, long, and tapering. Offices had to be contrived on the ground floor for special use, and are so shown, with a large general office in the front and smaller offices for clerks and typists behind it, all top lighted from areas or side lighted from a small area at farther similar rooms on the second floor and attic. The method of lighting is particularly noticeable, and the clever way in which the areas are used; and although there appears at first sight to be some little difficulty in the construction, this could easily be got over by the

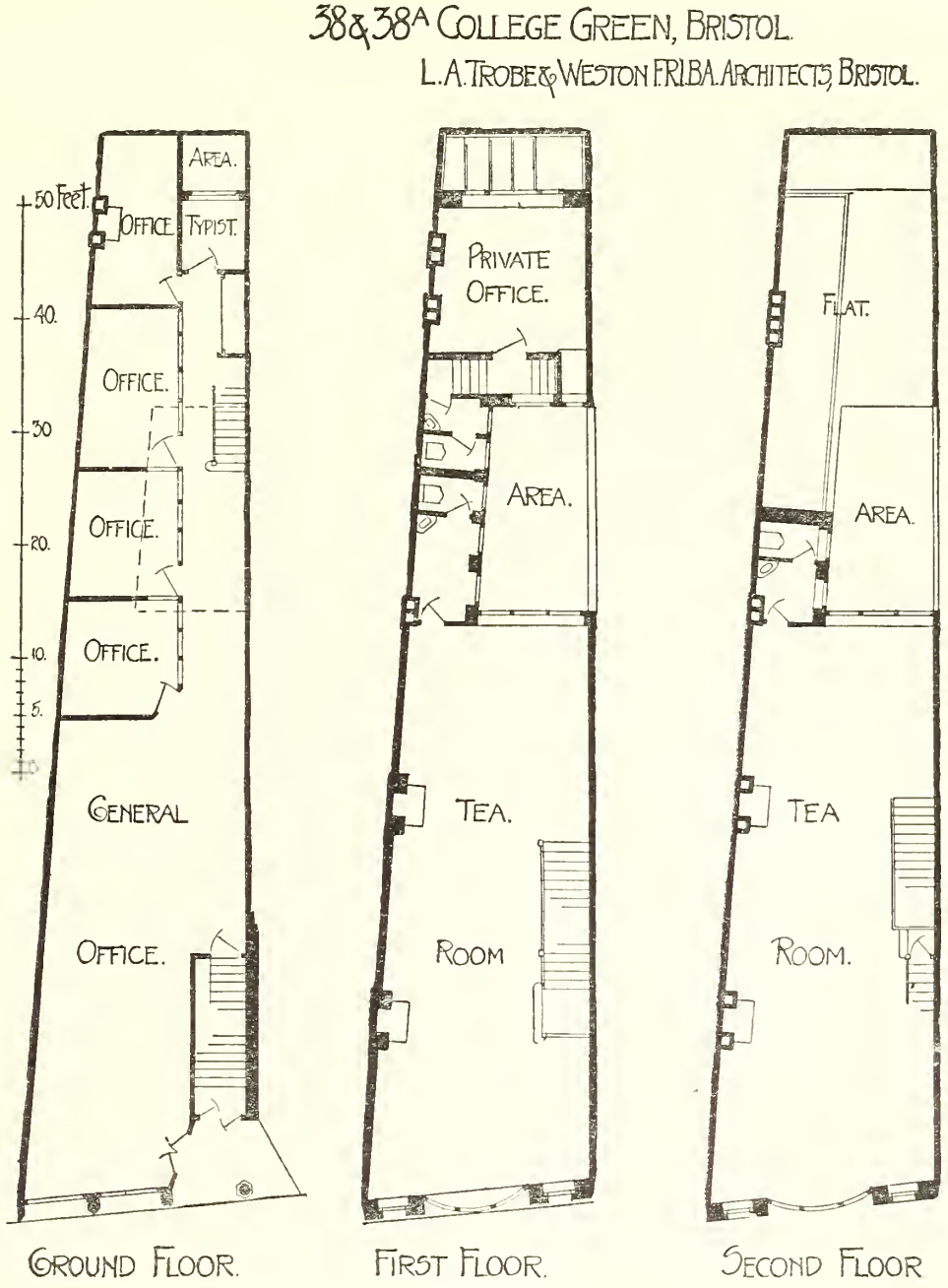


FIG. 22.

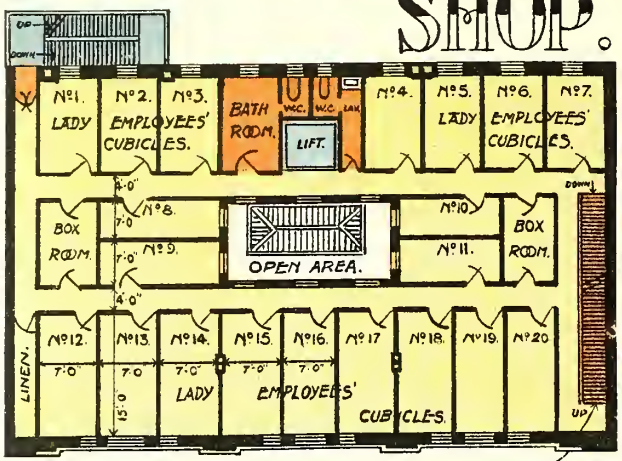
the back, where there is also a private staircase leading up to a small private office and lavatories. Under the main staircase, in the front, a small stair leads down to basement storerooms. Out of the recessed entrance, after passing through double doors, a wide staircase leads up to a tearoom on the first floor, and so up to

use of steel girders. This is an example of a combination of shops and offices in which the offices occur on the ground floor and the shops above, thus reversing a very general scheme. Shops and offices of this description would be closed at night time, unless special provision were made for a resident housekeeper, as

would always be done in the case of large offices which could hardly be left without a caretaker. It is quite customary, however, to shut up small suites of offices and small shops.

In the case of larger shops the arrangement is entirely different. They ought to be designed with special reference to the trades to be carried on in them, and in many instances provision has to be made for a large staff of assistants to live on the premises. This is particularly the case in drapers' establishments, of which an example is shown in Plate III. Here the ground floor is planned to provide a large amount of counter space, as well as plenty of room between the counters for the public to move about, with the usual narrow space behind the counters, and shelving again behind that, against the walls. There are three entrances to the shop from the street, and opposite the central one is placed a large lift which passes right up the whole building, as does also a small kitchen lift in one corner. A broad staircase winds round the lift up to the first floor, and under it is arranged an office for a cashier, with a small book lift to a similar office on the next floor, and well contrived stairs down to a safe in the basement. At either end of the frontage there is an entrance, one for employees on the right, and one for stores on the left, where there is a passage way to the back, communicating there with an external iron staircase carried both up and down. The basement is also reached by a stair from behind one of the counters underneath the employees' stair, and contains a large goods store which can be supplied through lifting pavement lights, and can itself supply the shop and showrooms by means of the lift. A heating chamber and coal store are found at the back on the left-hand side, and are balanced by kitchen stores and larder on the right. The first floor is given up to a large showroom with two retiring or dressing-rooms for customers, and a tearoom (such as large drapery establishments now generally contain), supplied from the kitchen above by the kitchen lift. Thus, so far as the shop is concerned, the convenience of customers has been studied, together with the provision of as much counter and show space as possible. It will be seen that large stanchions are carried up so far in the middle of the building, and that care has been taken to make them interfere as little as possible with the general convenience of working. These and the girders they carry enable fire-resisting floors of concrete and steel to be used, so that it is possible to place partitions on the upper floors wherever most convenient. This is taken advantage of largely, and the second floor is devoted to a general office for the use of clerks, out of which a safe and private office open, all easily reached by the external service staircase, the rest of the floor being given up to the living rooms of the employees, and their kitchen. It is not necessary to provide a very large dining-room, as, except on Sundays, there would always be double meals, for at no time could more than half the staff be spared from the counters. This dining-room is placed close to the employees' staircase and the kitchen, which latter is over the tearoom, and is provided with scullery and store. Probably, however, the employees would travel to and from their work by means of the lift, which on this floor opens upon a large central hall, from which the dining-room is also accessible, as well as two comparatively large rooms for private use by the men and women respectively. The third floor and attic are given over to small bedrooms or cubicles, the women being located on the third floor and the men in the attic. On each of these floors there are twenty such bedrooms, two boxrooms, and a linen-room and bathroom, arranged round an open area, with well lighted passages, and all served by the lift. Of course the rooms are small, but such an arrangement would probably be very much better appreciated than the provision of comparatively large dormitories. It will be seen that a building of this nature is a combination of a shop with something very like a hotel.

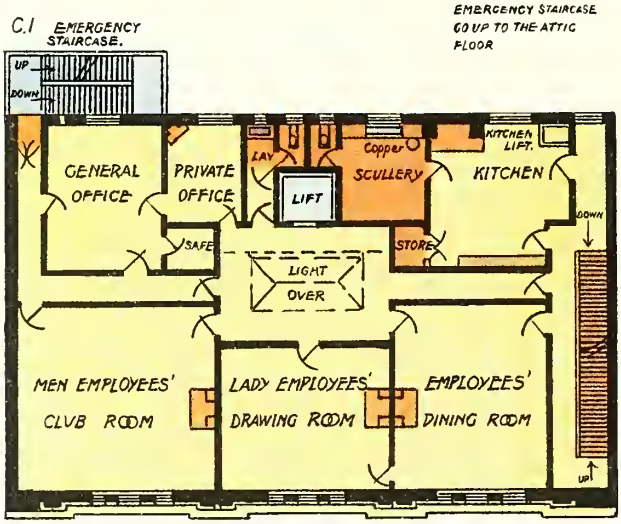
DESIGN FOR A DRAPER'S SHOP.



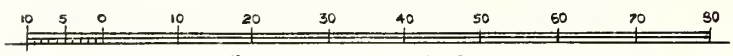
THIRD FLOOR.

MEN EMPLOYEES' CUBICLES ON THE ATTIC FLOOR

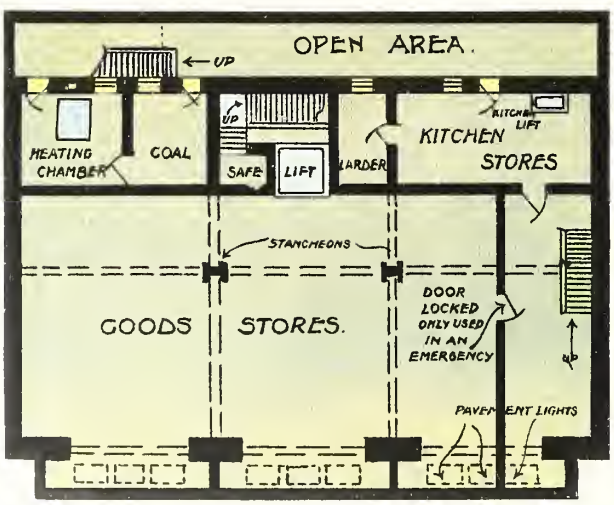
BOTH THE LIFT & EMERGENCY STAIRCASE GO UP TO THE ATTIC FLOOR



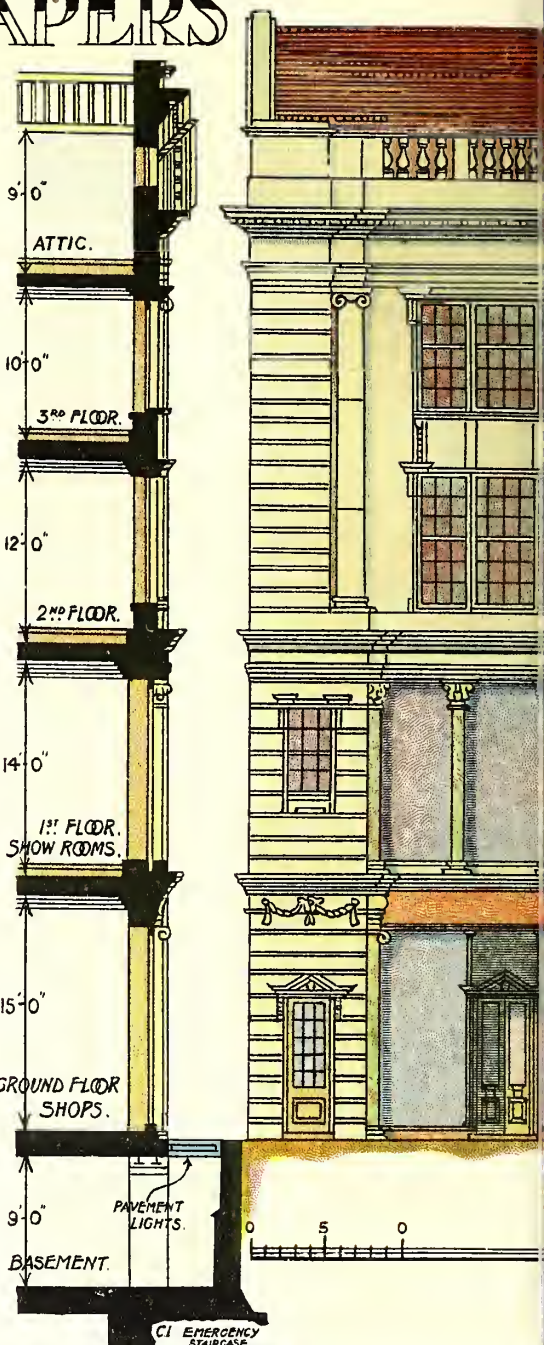
SECOND FLOOR.

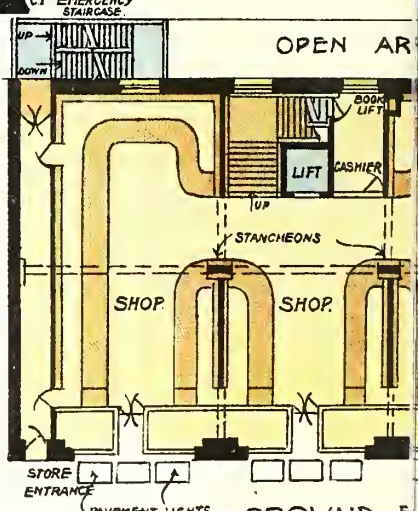


SCALE OF FEET FOR PLANS.



BASEMENT PLAN.





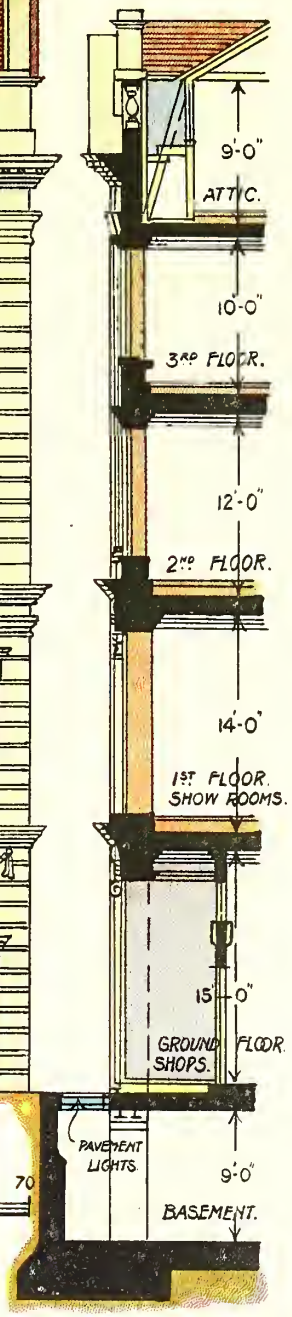
GROUND F

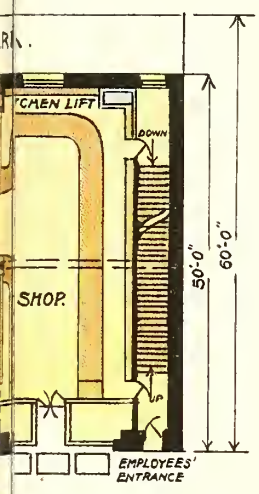
PLATE III.

FRONT ELEVATION.

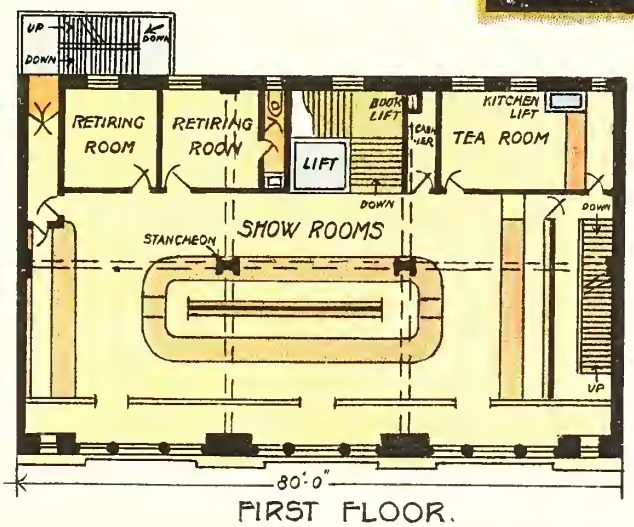
20 30 40 50 60 70

SCALE OF FEET





FLOOR.



FIRST FLOOR.

PART II

SPECIFICATION WRITING AND QUANTITY SURVEYING

CHAPTER I

SPECIFICATION FOR A DRAPER'S SHOP

(*Anonymously Contributed*)

THE following Specification is started at "Excavator," but should of course be preceded by such extracts from the General Conditions as might either directly or indirectly affect the price, and such general items as the paying of fees, provision of hoarding, and scaffolding, etc. ; and sheds for workmen, taking up stacking and relaying paving, etc., all of which would be included under the heading of *General Conditions and Preliminaries.*

It is intended to apply generally to such buildings as the draper's shop illustrated in Plate III., and it has been prepared in conformity with the best London practice, giving as much assistance as possible to the quantity surveyor and the builder, every item being easy to find and clearly specified. At the same time, it should in no case be slavishly copied, but be rather treated as a skeleton model on which to base other work of similar character.

SPECIFICATION

NOTE.—*Alternative methods and materials are printed in Italics*

EXCAVATOR, BRICKLAYER, AND DRAINS

Provide for keeping all excavations clear of water by baling, pumping, or otherwise.

Level and Ram.—Level and ram the bottoms of all excavations to receive concrete.

Shoring.—Provide all requisite shoring and strutting to trenches and to sides of excavation.

Sand.—The sand to be clean sharp river or pit sand of good angular grit, and free from loam or other impurities.

Lime.—The lime to be well-burnt ground [1](blue lias lime) [2](grey stone lime of moderate hydraulicity).

Cement.—All cement to be best Portland from an approved manufacturer, in accordance with the specification issued by the engineering standards committee for this particular class of work, and is to be spread in a dry shed to cool before use, but not to be allowed to become inert.

Concrete.—The concrete for foundations to be composed of one part of blue lias lime (*Portland cement*), to six parts of clean (ballast) or (*broken brick* or *broken stone*) and sand by measure, to be turned over twice dry, and then to have sufficient water added gradually through a rose to bring it to the required consistency and shovelled to a third heap ; to be mixed in sufficient quantities only for immediate use, gently tipped into position and lightly rammed with a wooden rammer till the scum rises to the surface.

Concrete for Floors.—To be composed of Portland cement and clean ballast or (*brick* or *stone*) and sand, otherwise as last described and laid to falls, currents, etc., or as required.

Aggregate.—The ballast (*brick* and *stone*), etc., for concrete to be broken small, no piece to be larger than will pass through a 2-inch ring for foundations in concrete, and a $1\frac{1}{2}$-inch ring for surface concrete and floors.

Coke Breeze Concrete.—The concrete for upper floors and ground floors where there is a basement to be composed of one part of Portland cement to six parts of coke breeze broken to pass a $1\frac{1}{2}$-inch ring, and screened from small stuff that will pass a $\frac{1}{4}$-inch mesh, to be mixed as previously described and deposited on flat boarded centering.

Lime Mortar.—The lime mortar to be composed of one part of lime as described to three of sand by measure, mixed in sufficient quantities only for one day's use.

Cement Mortar.—The cement mortar, unless otherwise specified, to be composed of one part of Portland cement to five parts of sand by measure, mixed in sufficient quantities only for use within one hour, and no cement which has commenced to set is to be used.

Bricks.—The bricks (except the facings) to be sound, hard, well-burnt stocks (*or as the case may be*), even in size and true to shape, equal to samples to be submitted to and approved by the architect.

Brickwork.—The brickwork to be executed in the best possible manner in English bond, flushed up solid in mortar, carried up regularly all over the building; no portion to be more than 3 feet higher than any other portion at the same time; the joints to be even in thickness, and the perpends truly kept and no four courses of brickwork to rise more than 1 inch higher than the height of the courses laid dry. No bats will be allowed except where requisite for the bond.

Facing Bricks.—The bricks for facings to be picked stocks (*or as the case may be*), sound, hard, true to shape and even in colour, to be laid Flemish bond and no false headers to be used, the joints to be raked out $\frac{3}{4}$ inch, and pointed with a neat bevel joint as the work proceeds, and the work cleaned down as the scaffolding is removed.

Glazed Bricks.—The glazed bricks are to be obtained from Messrs. —— or other approved makers, free from all defects or blemishes in the glaze, which is to be leadless and well fused into the brick.

Firebricks.—The firebricks to be best quality from approved manufacturers.

Excavation.—Excavate the basement, and the trenches for foundations, to the several widths and depths shown or figured on the drawings; return, fill in and ram earth around walls and foundations, and basket out and cart away the surplus.

Excavate the trenches for water and other pipes, and fill in and ram and basket out and cart away the surplus.

Brick Rubbish.—Lay 6 inches of hard, dry brick rubbish under all basement floors, and level and ram to receive concrete.

Foundations.—Fill in to trenches for foundations with concrete as described to the several depths shown or figured on the drawings.

Basement Floors.—Lay the basement floors, yards, and areas with 6-inch Portland cement concrete laid in two operations, the lower 4 inches to be of concrete as described and the upper 2 inches (laid while the lower is still green) to be composed of one part of Portland cement to two of granite chippings to pass a $\frac{3}{4}$-inch mesh finished smooth as paving. Where in open areas, it is to be laid to falls and currents.

Upper Floors.—Lay the ground and upper floors and flat with coke breeze concrete as described, laid between the rolled-steel joists on flat boarded centering, including the requisite hangers, the concrete to be 2 inches thicker than the depth of the joists (1 inch above and 1 inch below joist), and 6 inches thick at least, and floated on top $\frac{3}{4}$ inch thick in Portland cement and sand (1 to 2) to receive wood block flooring or pavings.

Lobbies and Escape Doors.—Pave the lobbies to escape doors with cement and granite chippings as described to basement floor.

Form curb to lantern light in flat in the concrete, including the necessary vertical boarding, and form groove in same for water bar.

Allow for bedding wood joists in concrete of third and attic floors (see Joiner).

Vaults.—Cover the vaults under pavement with 6-inch Portland cement concrete as described, and laid all as last described.

Concrete Partitions.—The concrete partitions (coloured on plans) to be of coke breeze concrete as described, 5 inches thick, filled in between vertical boarding laid in courses not exceeding 12 inches deep, each succeeding course laid while the previous one is still green; the partitions to have $\frac{5}{8}$-inch diameter wrought steel rods running through same vertically not more than 8 feet apart, and from ends of partition, the rods to be threaded at ends and secured to floors at top and bottom with nuts and washers.

Concrete Lintels.—Put over all door and window openings, except where otherwise specified, coke breeze concrete lintels 2 inches in depth for each foot or part of a foot of span, with steel bars bedded in same 2 inches from soffit as following table, one bar to each 9 inches or part of 9 inches of soffit; the lintels to be the full thickness of internal walls, and less the depth of reveals in external ditto :—

Clear Span not exceeding Feet In.				Bearing.
5	0	2 × 2 × $\frac{1}{4}$ in. T's		$4\frac{1}{2}$ in.
8	0	4 × $1\frac{3}{4}$,, H	5 lbs. per ft.	6 ,,
10	0	$4\frac{3}{4}$ × $1\frac{3}{4}$,, H	$6\frac{1}{2}$,,	$7\frac{1}{2}$,,
12	0	$5\frac{1}{2}$ × 2 ,, H	$10\frac{1}{2}$,,	9 ,,

Brick Walling.—Build the walls the various heights and thicknesses shown or figured on the drawings in brickwork in mortar as described, except where otherwise specified.

Brickwork in Cement.—Build the foundations and basement walls up to the level of front pavement, all brickwork in backing to stone, all half-brick walls, all brick piers less than 18 inches in width between windows (from sill to head only), and all parapets and chimney stacks above roof, in brickwork in cement as described.

Build the brick backing to stonework in brickwork in cement as described, and do all cutting and fitting of brick to stone.

Damp Course.—Lay damp course in all walls below the lowest floor and 6 inches above the level of ground, the width equal to the full thickness of wall and $\frac{1}{2}$ inch

thick of Limmer asphalt; and cut back ½ inch and point with cement where exposed.

Vertical Course.—Cover the vaults under pavements with similar asphalt ½ inch thick. Where lowest floor is below the level of outside ground cover the outer face of walls from damp course up to ground level with ¾ inch similar asphalt laid in two thicknesses, with angle fillets to all internal angles.

Cutting.—Do all circular cutting, cutting to skewbacks, chamfers, splays, bird's-mouths, squint quoins, etc., as may be required.

Bedding.—Bed all plates and other timbers requiring it.

Bed-Hollow.—Bed all stone sills in sand, and rake out and point in cement at completion.

Bed all door and window frames in lime and hair mortar, and point in cement.

Plugging.—Do all plugging required.

Beamfilling.—Beamfill all walls level with the underside of tiles.

Cut and Pin.—Cut and pin in cement all ends of stone, iron or wood requiring it, edges of slate shelves, etc., and pin up in slates in cement where required.

Oversailing.—Rough oversail as required in regular courses to carry wall-plates, etc.; no course to project more than 2¼ inches in front of the course below; oversail 2¼ inches over basement and in all rooms where cornices are shown to carry edges of concrete floor against walls.

Cut Chase.—Cut chase 1½ inches deep to receive edges of concrete floors in all other rooms.

Cut all chases required for pipes, etc.

R.W.P. Flashings.—Rake out, lead wedge and point in cement to all lead flashings and stepped flashings.

Chimney Arches.—Turn rough relieving arches in half-brick rings in cement over all chimney openings on and including ⅜ by 2 inches wrought-iron cambered chimney bars 18 inches longer than the openings, and caulked up and down at ends; arches under 4 feet span to be in two rings and over 4 feet in three rings.

Cut Holes.—Cut all holes required for pipes, etc., and make good.

Core and Parge.—Core and parge all flues with cement mortar trowelled smooth.

Render Backs.—Render all chimney backs in cement mortar.

Set Stoves.—Set all stoves and kitchener, with back boiler with all necessary firebrick, fireclay, etc.

Chimney Pots.—Provide and fix to all chimneys except the two front ones approved terra-cotta chimney pots, p.c. 3s. each, set and flaunched in cement.

Sink.—Provide and fix where shown in scullery approved best stoneware sink, size 3 feet 6 inches by 1 foot 9 inches by 7 inches deep in the clear, supported on approved cast-iron cantilever bracket, the edges against walls to be supported on brick oversailing courses.

Fair Face and Limewhite.—Build the internal faces of all walls in basement with fair face, and point with a flat point with edges cut as the work proceeds, and twice limewhite.

Fair Face and Pointing.—Build the backs of all parapets fair face, and rake out joints and point in cement as described to facings.

Facings

Face the external walls except the front wall with picked stocks as described.

Arches.—Turn neatly axed segmental arches over all external reveals except to front.

Oversailing.—Oversail as shown at eaves, etc., and to form chimney caps.

Copings.—Put to top of all boundary and parapet walls, except to front, brick on edge coping, set and pointed in cement on two courses of tile creasing to break-joint, set and weathered in cement.

Cramps.—Put to ends of brick on edge copings galvanised iron cramps, two to each 9 inches in width.

Fair Cutting.—Neatly cut the facings to all rakes, skewbacks, etc., and do all fair circular cutting to arches, etc.,

Make good facings to ends of steps, sills, etc., and neatly cut and fit same around pipes, etc., as may be required.

Glazed Brick Facings

The internal faces of walls of w.c.'s, lavatories, and bathrooms to be faced with first quality white glazed bricks as described, laid in Flemish bond in cement mortar with fine joints.

Half-Brick Partitions.—The half-brick partitions between w.c'.s and lavatories, etc., to be in glazed bricks as above, laid in stretcher bond.

Cutting.—Neatly cut and fit the glazed brick facings around pipes, fittings, etc.

Arches.—Turn arches over all door openings and internal reveals of windows in walls faced as above in two half-brick rings in cement with bull-nose angles.

Bull-Nose Angles.—The angles of all reveals and other salient angles in glazed work to be bull nose with proper mitre and springer blocks at sills and springing of arches.

Window Sills.—The window sills in internal reveals of windows in glazed work to be in glazed bull-nose bricks on edge.

Drains

The drain pipes to be Doulton's best "tested" socketed glazed stoneware pipes sound and straight, the joints made with neat Portland cement, and each joint cleaned off before the next one is made.

The drains to be laid on a bed of Portland cement concrete 6 inches thick and 12 inches wider than the outside diameter of the pipe; each pipe to rest on a blue brick set in cement, and the concrete flaunched up to pipe.

Excavate for and lay the drains as shown on the

drawings of the several diameters figured thereon, and to falls of not less than 1 in 40 for 4-inch drains, and 1 in 60 for 6-inch drains, unless otherwise indicated on the drawings, with all necessary bends, junctions, etc.

Traps.—Provide and fix under all rain-water pipes, sink and bath wastes, etc., and where shown in yard, Bolding's or other approved gulley traps and 6-inch galvanised iron gratings with 4-inch outgoes, p.c. 8s. each, set on and including Portland cement concrete bed 6 inches thick at least, and properly connect to drain.

Side Inlets.—The traps under waste pipes to have side inlets for same.

Disconnecting Traps.—Provide and fix on sewer side of disconnecting chamber a Winser's or other approved 6-inch disconnecting trap with cleaning arm and cap, and set on and including a cement concrete bed, and properly connect to drain and manhole, and put 3-inch self-faced York stone lintel over same in wall of manhole.

Manholes.—Excavate for and build the manholes of the several dimensions shown or figured on the drawings in 9 inches brickwork in cement with proper footings, and cement concrete bottom 9 inches thick at least, and benched up to channel pipes ; render the sides and bottoms in cement and sand (2 to 1) 1 inch thick, finished with neat dry cement trowelled in on surface. Corbel out tops for and provide and fix Bolding's galvanised iron air-tight cover and frame, p.c. . The grooves in frame to be filled with an approved mixture of tallow and oil. Cut all holes for pipes and make good. Provide and set in bottom of manholes, Winser's or other approved best white glazed channel pipes and three-quarter pipe bends, the bends to deliver over the top of main channel.

Foot Irons.—Where manholes are over 3 feet in depth provide and build in approved galvanised cast-iron horse-shoe foot irons 18 inches apart.

Ventilation.—Excavate for and lay 4-inch drain pipe as described from top of disconnecting chamber for ventilator, with bend at end and short length of 4-inch stout galvanised cast-iron ventilating pipe fixed to oak plugs in brick joints, and with Bolding's or other approved open balance galvanised fresh-air inlet, p.c. , jointed to pipe with tow and red lead.

Testing.—The whole of the drains are to be tested by water or other test as required at the expense of the builder, and approved by the architect before they are covered in, and again tested and approved after covering in, and all defects are to be made good.

Core out.—Core out all drains, and leave the whole of the drainage clean and perfect at completion.

Attendance.—Attend upon, cut away for, and make good after all trades requiring it.

MASON

Stone.—The stone throughout to be the best and hardest of its respective kinds, free from every defect, and to be laid on its natural bed and jointed in cement, with all requisite slate dowels, double plugs, copper cramps, lead, etc., and properly cleaned down at completion.

Portland Stone

The Portland stone to be the best selected Whitbed, free from clay or sandholes, black fossils, or other defects.

Front.—The whole of the front is to be faced with Portland stone, as described, worked and rubbed to detail drawings ; the plain ashlar to average 7 inches on bed ; the pilasters, cornices, pediments, dressings, etc., to be well tailed back and bonded to the brick backing as shown on the details.

Fit to Rolled-Steel Joists.—Properly cut and fit the stone cornices across shop and showroom windows to rolled-steel joists at back, and securely fixed to same with wrought-iron straps bolted to the girders, and secured to the stone with lewis bolts leaded in.

Carving.—Provide the sum of £ nett for carving to be executed by a carver selected by the architect. The builder is to perform the necessary bosting, and provide the necessary scaffolding, platforms, etc., and all cloths and other protection from inclement weather as may be required.

All window sills to be grooved for metal tongues

York Stone

The York stone to be from the Idle quarries, and of the hardest description.

Steps and Thresholds.—Put to all external doorways, except the shop entrances, rubbed top and front edge and back jointed steps and thresholds of the full width of walls.

Hearths.—Put to all hearths except where otherwise specified $2\frac{1}{2}$ inches rubbed front and back hearths with jointed edges set in cement.

Cover Stones.—Put on top of all rolled-steel joists carrying brick walls over, 3-inch self-faced cover stones with coped edges and of the full width of walls, and grooved as required for rivet heads.

Curbs to Pavement Lights.—Provide and fix around pavement lights 9 by 6-inch rubbed and rebated curbs.

Window Sills.—Put to all windows in back elevations rubbed, sunk, weathered, and throated sills $6\frac{1}{2}$ inches thick, grooved for metal tongues, and 6 inches longer than the openings, and 6 inches wider than the outside reveals.

Staircase to Basement.—The staircase from basement to ground floor is to have rubbed, rebated, and back-jointed steps bedded in cement, the ends cut and pinned 6 inches into wall in cement, and the external ends rubbed fair, the noses of steps and landings to be arrised and each step mortised for two balusters.

Landings.—The landings to be $4\frac{1}{2}$ inches thick, and thicknessed for top riser, rebated for steps, and mortised for balusters as required.

Corbels.—Provide and build in all requisite 3-inch self-faced corbels under projecting chimney breasts, etc.; built at least 9 inches into walls in cement, and of the sizes shown or required.

Templates.—All steel joists (except the small joists embedded in concrete floors and lintels) to have tooled templates built in cement, size 18 by 9 by 6 inches, unless otherwise shown or figured.

Base Stones.—Put under stanchions tooled base stones 6 inches thick of the sizes shown, bedded in cement and mortised for lewis bolts.

Marble Shafts.—Work and fix the shafts of columns to shop and showroom windows as shown in polished marble to detail.

Clean off.—Case up and protect all stonework, and clean off and leave all perfect at completion.

TILER

Tiling.—Cover the roofs with hard well burnt Broseley plain tiles from an approved maker, sound, true to shape and even in colour, laid to a 4-inch gauge on and including $\frac{3}{4}$ by 2-inch battens, and secured with two $2\frac{1}{4}$-inch copper nails to each, weighing $12\frac{1}{2}$ lbs. per M.

Hips and Valleys.—The hip and valley tiles to be purpose made to course and bond with the general tiling, and to include all cutting and fitting.

Ridge.—Cover the ridges with approved half-round red ridge tiles bedded and pointed in cement.

Eaves.—Lay double eaves course to all eaves.

Verges.—The verges to have tile and a half tiles to alternate courses bedded in hair mortar, and to have cement hollow fillet below.

Cutting.—Do all cutting required.

Hip Hook.—Provide and fix at bottoms of all hips approved wrought-iron hip hooks screwed to back of rafters, p.c. each.

Clean off.—Clean out all gutters, and leave roof sound and weather-tight at completion.

CARPENTER

Timber and Deals.—The fir and deals for carpenter's work to be the best well-seasoned red fir, free from sap, shakes, waney edges, large, loose or dead knots or other defects.

All timbers to be sawn die square and to hold the full sizes specified, and the work to be framed and executed in the very best manner.

Wall-Plates.—All wall-plates to be $4\frac{1}{2}$ by 3 inches, to be in long lengths halved and spiked at joints and halved and bolted at angles.

Floors.—Provide the 3 by 2-inch splayed fillets to third and attic floors as specified in Joiner.

Roofs.—Frame the roofs as shown on the drawings with the various scantlings as figured, the principal rafters to be tenoned to king-post at head and secured by 2 by $\frac{3}{8}$-inch three-way straps, and framed at feet to the beam and secured by 2 by $\frac{3}{8}$-inch heel strap and back-plate; the king-posts stub tenoned at feet to the tie beam, and secured by 2 by $\frac{3}{8}$-inch straps with forged ends and keys and cotters, the whole framed together and executed in the very best manner. The common rafter to be spiked to ridges, and notched and spiked to curbs and wall-plates, and notched and spiked over purlins. The roof below the curb to be framed as a partition with quarters or rafters framed into head and sill and with posts at angles and under principals, all to scantlings figured on the drawings.

Ashlering.—Frame the ashlering with 4 by 3-inch heads, posts and sills, and 4 by 2-inch quarters.

No rafters or quarters to be more than 12 inches apart.

All trimmers and trimmer rafters to be 1 inch thicker than the common rafters.

Centering and Turning Pieces.—Provide all necessary centering and turning pieces to flat, segmental, or other soffits, including the necessary strutting.

Flat-Boarded Centering.—Provide the requisite flat-boarded centering to concrete floors, to include the necessary hangers or horsing as may be required.

Cradling.—Provide and fix the necessary 2 by 2-inch fir bracketing and cradling to sides and soffits of steel girders for lathing or fixing joinery to, secured to 4 by 3-inch fir plates bolted through web with $\frac{3}{8}$-inch bolts every 3 feet, and blocked out as required.

Roof Boarding.—Cover the roofs with 1-inch rough batten boarding nailed to rafters with close joints.

Gutters.—Lay the gutters with 1-inch boards for lead on $2\frac{1}{2}$ by 2-inch bearers, framed where required with all necessary 2-inch deal rolls and 2-inch cross rebated drips and narrow risers, and form dished and rebated sinkings with holes for socket pipes.

Snow Cradling.—Put to all lead gutters snow cradling of 1 by 1-inch sawn fir fillets secured to $2\frac{1}{2}$ by 2-inch hollowed oak bearers not exceeding 4 feet apart, to be in lengths not exceeding 10 feet, and the whole to be twice tarred.

Felt.—Cover the roof with Croggan's (or other approved) inodorous roofing felt, well lapped and nailed.

Safes.—Put under cisterns $1\frac{1}{4}$-inch cross-tongued safes with 3 by $1\frac{1}{2}$ inch dovetailed rims rounded on top edge, and with dished and rebated holes for outlets.

Tilting Fillet.—Put to all eaves 3 by 2-inch deal splayed tilting fillets.

Fascia.—Fix to all eaves 1 by 7-inch wrought and beaded fascia secured to feet of rafters.

Rolls.—Provide and fix to ridges and hips of sky-lights 2-inch rounded deal roll, bird's-mouthed on, including all mitres and splayed and fitted ends, etc.

Trap Door.—Trim ceiling for and provide and hang $1\frac{1}{4}$-inch, ledged trap door, size 2 feet by 2 feet, hung on a pair of $2\frac{1}{2}$-inch wrought-iron butts to $1\frac{1}{2}$-inch rebated and beaded lining, and furnished with two 6-inch iron barrel bolts.

Cistern Enclosures.—Enclose the cisterns in roof with 1-inch V-jointed matched boarding, and two thicknesses of stout felt with a ledged top similarly made hung on a pair of 3-inch wrought iron butts, and furnished with oak turnbutton. The boarding to be fixed to 2 by 1-inch fillets with brass cups and screws. Do all boring for and fitting to pipes, etc

JOINER AND IRONMONGER

The deals and battens for the joiner's work are to be the best yellow, thoroughly well seasoned, free from sap, shakes, large, loose, or dead knots or other defects.

All other timbers hereafter mentioned to be of the best quality and thoroughly well seasoned.

All doors and other framings are to be got out and the panels slipped in, but not wedged up, as soon after signing the contract as possible, and allowed to stand in a warm dry shop until required.

All hardwood doors and framings over 2 inches thick and the lock rails of all doors to be double tenoned.

All glued joints are to be cross tongued.

All joiner's work is to hold when finished the *full* specified sizes and thicknesses.

All floor boards, skirtings, etc., where over gas or water pipes, bell wires, etc., are to be fixed with screws coated with tallow, so as to be easily removable.

Wrap all brass ware in tissue paper, and leave all bright and in proper working order at completion.

All joiner's work to include all necessary scribings, fittings, blockings, backings, pluggings, etc.

All work to be wrought where visible.

Floors and Skirtings

Lay the third and attic floors with 1-inch best yellow deal batten flooring, laid straight joint with splayed headings well cramped up and nailed with cut brads to 3 by 2-inch splayed fillets embedded in the concrete, the ½-inch space between concrete and floor boards to be filled with bitumen.

Lay the ground, first and second floors with 1⅜-inch wood block flooring supplied and laid by firms selected by the architect, and of the following p.c. values laid complete:—

Ground floor p.c. . . .	per yard super.
First floor ,, . . .	,,
Second floor ,, . . .	,,

Margins.—Lay glued and mitred margins to all hearths.

Thresholds.—Put to shop entrance doors 4 by 2-inch oak threshold with rounded nosing, and 1-inch riser tongued to same, and lower edge scribed to paving.

Put similar thresholds to entrances to lifts with 1-inch beaded apron lining tongued on below, including backings fixed to edge of concrete floors.

Skirtings.—The skirtings to be tongued and mitred at angles and housed to architraves, etc., and secured to 2 by ¾-inch backings, and to be as follows:—

Shops and Dining, Drawing and Club Rooms and Offices on second floor, 11 by 1 inch moulded to detail.

Showrooms, 1¼ inch moulded 15 inches high, to detail.

Kitchen and all rooms with wood floors on third and attic floors, 9 by 1-inch torus.

Stallboard.—Form the stallboard with 1-inch wrought, grooved and tongued flooring well cramped up on and including 9 by 2½-inch fir joists spiked to the coke breeze concrete. Put to inner edge of stallboard 4 by 1-inch Honduras mahogany tongued and rounded nosing and 1-inch riser tongued to same.

Sashes and Frames

Skylight.—Put to area over second floor 2½-inch moulded and hipped bar skylight prepared for Grover's simplex lead-glazing slips; to have 1½-inch rolls for lead bird's-mouthed on to ridge and hips; to have lantern lights under, framed with 4 by 4-inch angle posts, 4 by 2-inch intermediate posts, 4 by 3-inch splayed heads and 6 by 3-inch oak-sunk, weathered, throated, check-throated, and grooved sills. Fill in with 2-inch ovolo moulded sashes fixed with 1 by ¾-inch beads mitred around inside and out, No. 4 sashes to be hung on steel centres and to have cut beads; and line around inside of opening with 1-inch wrought cross-tongued and beaded lining with 2 by 1½-inch moulded capping around top, all to detail.

Condensation Sinkings.—Sink and bore the bottom rail of skylight.

Sink and bore the bottom rail of lantern light for condensation water.

Windows.—All windows, except the front windows in shop and showrooms, are to have deal cased frames of 1-inch inside and outside linings, 1¼-inch pulley stiles, ¾-inch back linings, ⅜-inch parting beads, and 1-inch inside beads and 3-inch teak, sunk, weathered, check-throated and grooved sills, to be fitted with ovolo moulded sashes 2 inches thick where less than 10 feet super., and 2¼ inches thick where larger, divided by moulded sash bars as shown, and double hung with best flax lines, brass axle pulleys and iron weights, the frames to be grooved all round for finishings, and the front windows, where shown, to be in venetian frames.

Window Furniture.—Furnish the sashes with approved brass sash fasteners, p.c. each; approved brass hook lifts, p.c. each; and approved brass sash pulls, p.c. each.

Galvanised-Iron Tongues.—All wood sills to be tongued to stone, concrete, etc. with 1¼ by ⅛-inch galvanised-iron tongues bedded in white lead.

Architraves, Linings.—Finish around all windows with moulded architraves to detail on 2 by ¾-inch rough splayed and framed grounds; where there are internal reveals the windows are to have 1-inch wrought deal jamb and soffit linings rebated to frame,

tongued at angles and secured to 2 by ¾-inch backings plugged to walls.

Window Boards.—Put to all windows 1-inch wrought tongued and rounded window boards on and including fir bearers, with notched and returned ends, those to ground and first floor windows, except to kitchen, scullery, and w.c.'s to have 2 by 1-inch moulding tongued on beneath with mitred and returned ends.

Shop Sashes in Honduras Mahogany.—Frame the shop sashes in Honduras mahogany, french polished, with 2½ by 3-inch rebated and moulded head and sill, 2½ by 2½-inch rebated and moulded stiles, and turned, rebated, and moulded angle columns with moulded caps and bases, all fitted with movable glazing mouldings fixed with brass cap and screws, 4½ by 4½-inch twice rebated, three times moulded and hollowed door posts, 4½ by 4½-inch twice rebated, and three times moulded transoms, and 4½ by 3-inch rebated and twice moulded head, all to detail. Enclose at back of stallboard with 2¼-inch moulded sashes, the lower portion to slide on approved steel runners and brass wheels, all fitted with movable mouldings for glass fixed with brass cups and screws, the whole to detail.

Showroom Windows in Honduras Mahogany.—The showroom windows are to be framed in Honduras mahogany, french polished, with 2½ by 3-inch rebated and moulded sills, and 2½ by 2½-inch rebated and moulded stiles and rails, all furnished with loose glazing mouldings fixed with brass cups and screws, all to detail, and grooved all round for linings, etc.

Linings in Honduras Mahogany.—Line the jambs and soffits with 1¼-inch panelled and moulded linings to detail, rebated to frame and tongued at angles on 2½ by 1-inch backings, and finish around with moulded architraves on rough splayed and framed grounds.

The window boards are to be in mahogany as above, 1¼-inch cross-tongued, rebated, and rounded on edge with notched, mitred, and returned ends, and 2 by 1-inch moulding tongued on beneath with mitred and returned ends.

Fascia.—Provide the sum of for shop fascia, lettered and fixed complete, and line soffits behind same with 1-inch Honduras mahogany, french polished, and finish along inside with architrave moulding to detail, carried around top of windows, etc., as shown.

Doors and Framings

All basement doors to be 2-inch framed and braced filled in with ¾-inch V-jointed, grooved, and tongued boarding in narrow widths, the doors to be each hung on one pair of 4-inch wrought-iron butts, to 4½ by 3-inch wrought, rebated and beaded frames, and furnished with mortise-dead locks, p.c. each, and wrought-iron Norfolk latches, p.c. each; the outer doors to have in addition two 8-inch iron barrel bolts to each.

The external door to escape staircase on all floors to be of Indian teak 2 inches thick, framed solid and bead flush, both sides in six panels the set, hung folding on one pair to each leaf 4-inch brass butts, and furnished with approved self-acting emergency bolts, p.c. the set.

The front entrance doors, except to shops, to be 2¼-inch two-panel bead-flush and bolection-moulded doors, the upper panels open and divided into small squares by 1½-inch moulded sash bars, and with loose hardwood mouldings and brass cups and screws for glass, hung on 1½ pairs of 4-inch wrought-iron butts to 5 by 4-inch wrought, rebated, moulded, and beaded frame, and furnished with night latches, p.c. each, and two 8-inch iron barrel bolts to each and 6-inch dead locks, p.c. each.

Shop Doors.—The shop entrance doors to be 2¼-inch Honduras mahogany french polished doors, panelled, moulded, and bolection moulded in two leaves in No. 4 panels the set, the upper panels open for glass and with loose mouldings and brass cups and screws, to have rounded edges and to be hung on Smith's patent double-action check-spring hinges and top centres to frames previously specified under "Shop Sashes," the hinge boxes to be let into floors and charged with oil; these doors to be furnished with approved long brass handles and brass plates inside and out, p.c. the set, and one 18-inch brass barrel bolt and one brass monkey-tail bolt 42 inches long to each leaf.

Over-Doors.—Provide and fix over shop entrances moulded pediment over-doors to detail in mahogany as before specified.

Internal Doors.—All internal doors on ground and first floor to be 2 inches, four or five panel as shown, moulded both sides, hung on one pair to each 4-inch wrought-iron butts to 1½-inch wrought, rebated, and beaded linings secured to 2½ by 1-inch backings; where over 7 inches wide the backings to be dovetailed. The doors to be furnished with mortise locks and furniture, p.c. the set.

All other doors to be 2 inches, four or five panel as shown, moulded and square, hung as last described, and furnished with mortise locks and furniture, p.c. the set.

Architraves.—Put around all external doorways where frames are flush with the plaster, and around all internal doorways except in basement, moulded architraves of the several sections shown on detail on 2 by ¾-inch rough splayed and framed grounds.

Lift Enclosures—Enclose the lifts in staircase and in shop, showrooms, and tearooms, with 2-inch panelled, moulded, and square framing to detail with solid quadrant corners. Enclose the lifts elsewhere with 2-inch framed and braced enclosures filled in with ¾-inch V-jointed, grooved, and tongued boarding in narrow widths, and with solid quadrant corners.

The entrances to lift to have doors to match the enclosures, hung on steel runners and brass wheels, and furnished with patent spring catch and key.

Stairs

Frame the main stairs from shop to showroom in teak with 2-inch treads with moulded nosings and 2-inch risers rebated and screwed together, glued, blocked, and bracketed on and including 4½ by 3-inch American oak carriages, the ends of treads and risers housed to 2-inch moulded wall strings ramped as required, and mitred at angles.

The employees' stairs to be similar, but with 2-inch moulded and beaded close outer string.

Landings.—The landings to be 2-inch teak cross tongued on 4½ by 2-inch American oak bearers.

Nosings and Apron Linings.—Put to edges of landings 4 by 2-inch tongued and rounded nosings, and 1-inch rebated and beaded apron linings.

Handrails.—To be Indian teak french polished, moulded to detail; that to shop stairs to be supported on 2-inch teak turned and moulded balusters to detail, tenoned both ends, and that to employees' staircase on 2-inch square teak balusters, tenoned both ends; where against wall or partition, to be supported on cast-iron hand-rail brackets, p.c. each. The hand-rail to basement stairs to be 2-inch rounded birch prepared for core-rail.

Newels.—The newels to be in Honduras mahogany to detail, to be fixed to concrete floors with galvanised iron dowels run with lead, and the wood flooring cut and fitted around.

The ends of strings and handrails to be housed to newels, also the ends of risers and the ends of treads notched and fitted to ditto.

Counters.—The counters to be in Honduras mahogany french polished, with 1¼-inch top thickened to 2½ inches on front edge, and moulded, and to 2 inches square at back; the front to be 1¼-inch framed, panelled and bolection moulded with pilasters, consoles and moulded plinth as shown, the ends and divisions to be 1¼ inch deal-framed, fitted at back with deal drawers and cupboards as shown; the drawers to be dovetailed with 1¼-inch bead butt fronts and ⅝-inch sides and bottoms on wainscot runners, and furnished with drawer locks, p.c. each, and brass handles; the cupboards to have 1¼-inch square framed doors hung on a pair of 3-inch wrought-iron butts to each, and furnished with cupboard locks, p.c. each, and brass knobs and turn buckles; fit up with 1-inch cross-tongued shelves on 2 by 1-inch wrought chamfered bearers and 1-inch cross-tongued bottom and bearers and 1 by 4-inch wrought chamfered plinth, the whole to detail.

Form quadrant corners to counter where shown.

Form flaps in counter top where shown, hung on 2-inch brass counter hinges and furnished with brass flap-catch, and form wickets under same in counter front hung on a pair of 3-inch brass butts to each, and furnished with 4-inch brass barrel bolts (one to each).

Pipe Casing.—Provide and fix where directed feet super. of 1-inch wrought deal pipe casing, fixed with brass cups and screws to 1½-inch wrought, rebated, and beaded grounds.

Shelving.—Provide and fix in kitchen store as shown one row of 1-inch deal cross-tongued shelving on 3 by 2-inch wrought deal uprights and bearers cut and pinned into walls with one row of 1 by 11-inch and one row of 1 by 9-inch wrought deal shelving over on 2 by 1½-inch wrought deal gallows brackets, including all requisite ship lap joints, etc.

Provide feet super. of 1-inch wrought deal cross-tongued shelving on and including 2 by 1-inch wrought deal chamfered bearers and backings plugged to walls, and fix where directed.

Mantel Shelf.—Put in kitchen 1½-inch wrought deal mantel shelf 9 inches wide, with rounded corner and fitted end on cut and wrought brackets, cut and pinned into wall.

Meter Shelf.—Provide a 1¼-inch wrought deal cross-tongued meter shelf on 2 by 1½-inch wrought deal framed brackets plugged to wall, and fix where directed.

Draining Board.—Provide and fix to scullery sink as shown 1¼-inch teak grooved draining boards with rims fixed on, and including 2 by 1½-inch wrought deal chamfered bearers.

Dresser.—Provide and fix where shown in kitchen proper framed dresser 6 feet long and full height of room with 2 inches wrought deal top 2 inches thick and 18 inches wide, with rounded edges fixed on 3 by 3-inch wrought deal legs and 3 by 1½-inch bearers with 1¼-inch pot board and bearers below and 1-inch skirting and 1 row of proper dovetailed drawers as described to back of "Counter," complete with knobs and drawer locks and four tiers of 1¼-inch shelves on 2 by 1-inch wrought chamfered bearers, 4, 7, 9, and 9 inches wide respectively, grooved for plates and fitted with brass cup-hooks, and 1¼-inch shaped ends and divisions and 1 inch fascia and 3 by 2-inch cornice at top and ¾-inch matched and V-jointed back, all framed together to details.

Letterplate, etc.—Pierce door for and fix approved brass letterplate, p.c. , and put galvanised wire letter cage inside, value p.c. .

Attendances.—Provide all necessary attendances on other trades requiring it.

Smith and Founder

Iron.—The iron, both cast and wrought, and the rolled steel to be of the best quality and brands approved by the architect; and, except where bedded in concrete, to be painted two coats of granitic oxide before fixing.

Castings.—All castings to be perfectly smooth, and free from flaws, sandholes, and other defects.

Provide all requisite patterns.

Wrought Iron.—The wrought iron to bear an ultimate tensile stress of 22 tons per square inch of section, with a contraction of area at fracture of 18 per cent.

Steel.—The steel to bear an ultimate tensile stress of

not less than 27 or more than 32 tons per square inch of section, with a contraction of area at fracture of from 50 to 40 per cent. accordingly.

Testing.—Suitable samples of the various sections of wrought iron and steel to be provided for testing.

Cast Iron

Eaves Gutters.—Provide and fix to eaves 5 by 4-inch stout cast-iron moulded eaves gutters, No. in Messrs. 's catalogue, with all requisite angles, stopped ends, spigot outlets, etc., and jointed in red lead, and bolted together and screwed to fascia.

Rain-Water Pipes.—Provide and fix where shown stout cast-iron rain-water pipes, the joints made in tow and red lead, fixed with wrought-iron dog nails to oak plugs in brick joints with all necessary bends, swan-necks, shoes, etc. ; to be of the following sizes and weights :—

Position.	Size.	Weight per 6 Ft. Length.

Heads.—The rain-water pipes to have moulded heads where shown, No. in Messrs. 's catalogue.

Pavement Lights.—The pavement lights to be semi-prismatic, 4 by 3 inches, with convex lenses in alternate rows, to have approved weather bar at back, and to be obtained from Messrs. .

Wrought Iron

Chimney Bars.—Provide and fix to all chimney openings 2 by $\frac{3}{8}$-inch cambered chimney bars caulked up and down at ends.

Rolled-Steel Joists.—Provide, hoist, and fix the rolled-steel joists of the various sections shown or figured on the drawings, with all necessary angle plates and cleats, fish-plates, holes, bolts, and connections as shown.

The small joists embedded in the concrete floors to be in long lengths where possible, with butt joints over girder connected with $\frac{1}{4}$-inch fish-plates and one $\frac{1}{2}$-inch bolt and nut to each side of joist. Where these joists abut against side of main girders they are to be cleated to same with one $\frac{1}{4}$-inch angle cleat, and No. 2 $\frac{3}{8}$-inch bolts to each.

Bearing.—All joists to have bearings at each end of not less than their depth, and no bearing to be less than 6 inches.

Stanchions.—The stanchions to be of wrought steel built up to details, with cap and base plates and brackets riveted on as shown.

No rivet hole to approach nearer the edge of the plate than its own diameter.

The b[illegible]es of stanchions to be run with cement, and secured to base stones with No. 4 to each $1\frac{1}{8}$-inch lewis bolts 8 inches long leaded to stone.

Core Rails and Balusters.—The handrail to basement stairs to have $1\frac{1}{4}$ by $\frac{1}{4}$-inch core rail screwed to same, and $\frac{7}{8}$-inch square balusters two to each step let in and run with lead and screwed to core rail with stove screws.

Cisterns.—Provide one 350-gallon and one 200-gallon galvanised wrought-iron riveted cisterns of $\frac{1}{8}$-inch metal with tension rods across same to stay sides and angle irons at top and angles, and hoist and fix where shown in roof on and including the requisite T-iron bearers. Cut and drill all holes required for plumber.

Grates and Range—Provide the sum of £ nett for grates and ranges, and add profit and carriage.

Mantelpieces.—Provide the sum of £ nett for mantelpieces, and add for profit, carriage, and fixing complete.

Escape Staircase.—Provide the sum of £ nett for cast-iron escape staircase, delivered and fixed complete from basement to attic floor.

Lifts.—Provide the sum of £ nett for passenger lift, delivered and fixed complete with all guides, gearing, etc.

Lifts.—Provide the sum of £ nett for kitchen lift, delivered and fixed complete.

Allow for attending upon, cutting away for, and making good after escape staircase and lift engineers in all trades.

Iron Guard Railings.—Provide the sum of £ nett for wrought-iron movable guard railings to shop fronts, with gates in same and gun-metal locks and fastenings, and fitting to shop front complete, and add for profit and attendance.

Electric Bells

Provide the sum of £* nett for electric bells to be expended under the direction of the architect, or deducted in whole or part from the amount of the contract.

Electric Lighting

Provide the sum of £* nett for electric lighting and fittings, to be expended as above described.

HOT-WATER ENGINEER

Pipes.—The pipes to be the very best strong galvanised wrought-iron steam piping of approved make, with all necessary short lengths, elbows, reducing sockets, T's and X's, bends, etc. (bends to be used in preference to elbows), and fixing with wall hooks.

All cocks to be Larbert's best gun-metal high-pressure screw-down stuffing box or other approved "hot water" cocks.

Cylinder.—Provide and fix where shown in kitchen,

* *Note.*—These provisional sums would be arrived at by obtaining a special quotation from a firm of electrical engineers.

strong galvanised wrought-iron hot-water tested cylinder, of Messrs. manufacture, to hold 50 gallons, fixed on wrought-iron T bearers, cut and pinned into walls, and drill all holes for pipes.

Flow and Return Pipes.—Connect up between boiler and cylinder with 1¼-inch flow and return pipes as described, with flanged and bolted connections.

Lay on from cold cistern to cylinder 1-inch lead supply, connected to cylinder with flanged and bolted connection and screw cap and lining tinned for lead pipe.

Take 1-inch flow and return pipes from and back to cylinder, and from highest point of system take 1-inch steam pipe through roof, including 6-lb. lead slate and tafted soldered joint to pipe, and make good roof to same.

Auxiliary Flow Pipe.—Connect the flow pipe *to* the cylinder with the flow pipe *from* same with 1-inch auxiliary flow pipe.

Take ¾-inch branches from nearest points on return pipe to the baths, lavatories, and scullery sinks.

Safety Valve.—Provide and fix on cylinder an approved safety valve.

Stop Cock.—Provide and fix on flow pipe from cylinder a 1-inch wheel stop cock.

Bib Cocks.—Provide and fix over scullery sink a ¾-inch bib cock.

The hot-water service to be thoroughly tested and left perfect at completion.

Attendance.—Attend upon, cut away for, and make good after hot-water engineers in all trades.

PLASTERER

Sand.—The sand to be clean, sharp and free from all impurities, and washed if required.

Lime.—The lime to be approved fat lime, that for the setting coat to be run into putty at least one month before it is required for use.

Cement.—The cement to be Portland, as described in Bricklayer.

Laths.—The laths to be lath and half heart of Baltic fir split laths with butt joints, the joints frequently broken, and nailed with galvanised wrought-iron nails.

Hair.—The hair to be best long cow hair well beaten, and used in the proportion of 1 lb. of hair to 3 cubic yards of mortar.

Float and Set—Float and set on concrete partitions.

Soffits of Concrete.—Hack soffits of concrete floors to form key for plaster, and dub out where required to form level soffit, and float and set same.

Render.—Render, float and set internal faces of all walls except where otherwise specified.

Lath and Plaster.—Lath plaster, float and set stud partitions.

Ceilings.—Lath plaster, float and set on wood joist ceilings, and soffits of stairs part flueing.

Cornices.—Run plaster moulded cornices to detail, including fir cradling or as required, and all mitres, mitred and returned ends fitted ends, etc., and of the following girths :—

Rooms.	Girth of Cornice.

Expanded Metal Lathing.—Cover the sides and soffits of rolled-steel joists with expanded metal lathing secured to the cradling for plaster or cornices.

Quirk.—Run plaster quirk against wood beads of apron linings, linings of skylights, etc.

Whiten.—Twice whiten ceilings and soffit of stairs.

Distemper.—Twice distemper to a selected tint with approved washable distemper all plastered walls, partitions, etc., except where otherwise specified.

Keene's Cement.—Set around stanchions in Keene's cement, on Portland cement grounds, on and including expanded metal lathing secured with stout copper wire.

Keene's Cement Angles.—All salient angles of plaster to be in " Keene's " cement, slightly rounded with 1-inch wings on Portland cement grounds.

Portland Cement.—Render and set in Portland cement for a height of 18 inches above scullery sink and draining boards with flush bead at top stopped.

TILE MASON

Lay the floors of scullery, bathrooms, w.c.'s, and lavatories, and wherever coloured red on plans, with approved red paving quarries, including all cutting and fitting.

Lay the hearth coloured red with tiles, p.c. per yard super. laid complete.

Lay the lobbies to shop entrances with mosaic, p.c. per yard super. laid complete, including all fitting.

Leave all clean and perfect at completion.

PLUMBER

The lead to be of the best description known as milled lead, to hold the full weights specified and to be free from all defects, to be laid in the best manner and well dressed down in valleys, gutters, flashings, etc., all edges to be cut straight, and to include all necessary solder, tacks, wall hooks, lead dots, welts, etc.

Externally

Gutters.—Lay the gutters with 6-lb. lead turned up 6 inches against walls, parapets, etc., going under tiles 9 inches at least, and to give a vertical depth of 6 inches.

Lay similar back gutters to all chimney stacks, etc.

Falls.—The gutters to be laid to falls of 2 inches in 10 feet, and with 2-inch drips not more than 10 feet apart.

Soakers.—Where sloping roofs abut against walls, stacks, skylights, etc., provide 4-lb. lead soakers, their length equal to the gauge and lap of tiling added together, and 8 inches wide, 4 inches under tiles and turned up 4 inches against walls, etc., one to each course of tiles, and to be fixed by the tiler.

Flashings.—Cover the upturned edges of lead gutters, etc., with 5-lb lead flashings 6 inches wide, turned into joints of brickwork or raglets in stone, and lead wedged and pointed (see BRICKLAYER), and where against woodwork to be close copper nailed and bedded in white lead.

Stepped Flashings.—Cover the upturned edges of soakers with 5-lb. stepped flashings 6 inches wide, and fixed as described to flashings.

Aprons.—Put to fronts of chimney stacks, skylights, etc., 5-lb. aprons 12 inches wide, fixed as described to flashings.

Laps.—All flashings, aprons, etc., to lap 3 inches at joints and 6 inches at angles.

Cesspools.—Line the cesspools with 6-lb. lead with soldered angles, and solder to outlets from same 3 inches diameter drawn lead socket pipes equal to 8-lb. lead, and bent as required.

Dormer Cheeks.—Cover the cheeks of dormers and the spandrel reveals of attic windows as shown with 5-lb. lead, copper nailed at top edges under tiles, and secured to boarding with brass screws and soldered dots, one to every superficial yard.

Wire Covers.—Provide and fix to all outlets of gutters, including the cast-iron eaves gutters, and to rain-water heads, stout copper wire covers ; those to gutter outlets to be domed.

Provide and fix stout copper wire balloon covers to tops of all lead ventilating pipes.

INTERNALLY

Pipes.—The lead pipes to be drawn of the best make, and to include all joints, tacks, wall hooks, bends, etc., and fixing complete.

Joints.—All joints to be wiped solder.

The whole of the internal plumber's work to be in strict accordance with the regulations of the Water Company, and to their approval.

The pipes are to be of the following weights :—

Diameter of Pipes.	Main Service.	Services from Cistern and Wastes from Sinks.	Other Wastes and Ventilating Pipes.
Inches.	Lbs. per Yard.	Lbs. per Yard.	Lbs. per Yard.
$\frac{1}{2}$	7	$4\frac{1}{2}$	$3\frac{1}{4}$
$\frac{3}{4}$	12	$7\frac{1}{2}$	$5\frac{3}{4}$
1	15	$10\frac{1}{2}$	$8\frac{1}{2}$
$1\frac{1}{4}$	21	14	12
$1\frac{1}{2}$	26	18	16
2	38	24	21
$2\frac{1}{2}$	...	30	$26\frac{1}{4}$

Lead Slates.—All pipes taken through roof to have 5-lb. lead slate tafted and soldered to pipe.

Safes.—Line the safes with 5-lb. lead turned over rim at edges and open copper nailed ; form outlet and solder on short length of $\frac{3}{4}$-inch lead pipe taken through roof with copper flaps on end.

Overflows.—Take from water-waste preventers $\frac{3}{4}$-inch lead overflows through wall, with copper flaps on ends.

Take from cisterns in roof $1\frac{1}{2}$-inch lead overflows through roof, with copper flaps on ends.

Wastes and Traps.—Put under scullery sink and lavatory basins 2-inch Dubois or Sutcliff drawn lead traps with brass cap and screw for cleaning, and take from traps 2-inch lead waste pipes through wall, and connect to main $2\frac{1}{2}$-inch waste carried up at least 3 feet above eaves, and connected at foot to side inlet of gulley with a brass thimble and wiped soldered joint ; the waste to be fixed with lead tacks as described to soil pipe.

Washer and Waste.—Provide and fix to scullery sink 2-inch brass washer and waste with movable grating.

Soil Pipe.—Provide and fix from w.c.'s a main 4-inch internal diameter drawn lead soil pipe equal to 8-lb. lead fixed with cast lead tacks not more than 3 feet apart to oak plugs in brick joints with moulded headed nails, connected at foot to drain with brass thimble and wiped soldered joint, and carried up above roof as shown as vent pipe, the branches from the w.c.'s to be of similar pipe bent as required and connected to traps of w.c.'s with brass collar and flanged and bolted joint.

Anti-Siphonage Pipe.—Take from the trap of lowest w.c. at a point 4 inches beyond the outgo a $2\frac{1}{2}$-inch anti-siphonage pipe secured with tacks as described to soil pipe, and connect to soil pipe 3 feet above top of highest trap ; take $2\frac{1}{2}$-inch similar branch pipes from similar points on the traps of upper w.c.'s, and connect to main anti-siphonage pipe with soldered branch joints.

Flushing Pipes.—Provide and fix $1\frac{1}{4}$-inch lead flushing pipe from w.w.p. cisterns connected to arm of w.c. with canvas and putty joint.

WATER SERVICES

Supply.—Open up roadway, etc., drill Company's main, fix 1-inch brass ferrule and lay 1-inch lead main from Company's main to front wall laid in rough deal trough and covered with pitch, and make good roadway and pavement to the satisfaction of the Authorities, or pay the Company for doing the work, and pay all fees.

Continue the 1-inch pipe as rising main to the two cisterns in roof.

Branch from rising main with $\frac{3}{4}$-inch pipe to draw off in area and scullery, and where indicated on plans.

Services.—Take from smaller cistern in roof $\frac{3}{4}$-inch service to baths and lavatories, with $\frac{1}{2}$-inch branches to water-waste preventers.

Take from larger cistern 1-inch service to hot-water

cylinder as previously specified, and branch with $\frac{3}{4}$-inch to scullery sink and over copper.

The following cocks to be Lambert's best high-pressure screw-down, with stuffing box, or others of equal quality approved by the architect:—

Stop Cock.—Provide and fix on rising main 1-inch brass stop cock, and on each service from cisterns brass stop cock of the size of the services.

Provide and fix in pavement 1-inch brass stop cock and cast-iron box and cover complete with key, and make good to the satisfaction of the Local Authorities.

Ball Valves. — Provide and fix in cisterns 1-inch approved brass equilibrium ball valves with brass rods and copper balls.

Bib Cocks.—Provide and fix $\frac{3}{4}$-inch brass bib cocks over sink and copper, and at point in area, and where shown.

Unions.—Provide and fix in cisterns all requisite brass screw unions, with screw cap and lining prepared for lead pipes.

Fittings

Lavatories. — Provide and fix in lavatories white enamelled stoneware basins with hot and cold cocks and waste complete, including cast-iron brackets, p.c. each set, and add for profit, carriage, and fixing, and all joints to pipes complete.

Baths.—Provide and fix in bathrooms approved cast-iron porcelain enamelled Roman baths, p.c. each, with hot and cold cocks and wastes complete, and add for profit, carriage, and fixing and all connections to pipes.

W.c.'s.—Provide and fix in w.c.'s 's approved pedestal wash-down w.c. apparatus complete, with hinged mahogany french polished seats, p.c. each, and properly connect to floor and make good tiling.

Water-Waste Preventers.—Provide and fix in w.c.'s 's 2-gallon water-waste preventers, p.c. each complete, with ball valves, unions for pipes, and ornamental cast-iron brackets.

Attendances.—Attend upon, cut away for, and make good after plumber in all trades. Leave the whole of the plumber's work proved and perfect at completion.

GLAZIER

Glass.—The glass to be of the best description of its respective kinds, free from all waves and air globules, and to be bedded in putty and back puttied and sprigged in.

All edges of plate glass to be blacked. All doors to be glazed in wash leather. The shop and showroom windows to be glazed in vulcanite.

Skylights. — Glaze the skylights with Pilkington's patent $\frac{3}{16}$-inch wired-cast plate.

Lantern Lights.—Glaze the side sashes of lantern lights with Hartley's $\frac{1}{8}$-inch rough plate.

Glaze the shop and showroom windows and doors with $\frac{1}{4}$-inch British polished plate.

Glaze all other windows and doors with 26-inch seconds sheet glass.

All windows opposite escape staircases to be glazed with Pilkington's fire-proof glass.

Painter and Paperhanger

The colours, white lead, and oil to be of the best description, and free from adulteration.

All woodwork to be carefully knotted and stopped, and all work to be well rubbed down between each coat.

All painting to be finished to approved colours and tints.

Iron.—Paint two coats of oil colour on all exposed ironwork after fixing.

Woodwork.—Prime and paint four coats of oil colour on all internal and external woodwork usually painted, the last two coats internally on ground, first and second floors to be in Gay's "Impenetrable" or Chancellor's "Velure" paint.

Stoves.—Black all stoves and range.

Touch up work and leave all clean and perfect at completion.

PAPERHANGER

The paper to be English of the best quality, hung in a workmanlike manner with a butt joint.

Size and prepare walls, and hang with papers of the following p.c. values:—

CHAPTER II

QUANTITIES: GENERAL PRINCIPLES AND SEQUENCE

(Contributed by W. H. Brown, F.S.I.)

The preparation of a Bill of Quantities consists of three operations, known as "Taking off," "Abstracting," and "Billing," and in this and the following chapters it is proposed to describe generally these three processes, together with the modes of measurement in each trade. First of all, a thorough knowledge of every detail of construction is absolutely necessary, and of the trade method of carrying it out, and this knowledge requires to be kept constantly up to date in order to avoid obsolete modes of measurement. Take, for instance, the case of drilling, say, twelve equidistant holes in an iron or steel plate. Formerly this would have taken twelve times as long as drilling one hole, but at the present time the twelve drills would be set to the required pitch, and the twelve holes drilled in one operation; from which it will be seen that if these holes were simply numbered without any note as to their position, the Contractor could not price them correctly. The great aim of the Quantity Surveyor should be to so measure and describe each item that the Builder will be able readily to understand it and accurately assess its value. If this principle be constantly kept in mind it will help the Surveyor over many a difficulty, especially where an unusual mode of construction is shown or specified.

It is proposed to deal with the three operations of "Taking off," "Abstracting," and "Billing" in the order in which they are performed,—the first operation being described as *Taking off* if the dimensions are taken from the drawings, and *Measuring* if they are taken from the actual building.

"Taking off," then, consists in taking the dimensions of the various items from the drawings and entering them with their proper descriptions on "dimension paper," each page of which is ruled for two columns of dimensions as below; and when the dimensions are taken from the actual building they are usually entered in a dimension book similarly ruled.

2/	242.0 20.0		1. B. in M.					

The first column on the left is called the *Timesing* column. Where the same dimension occurs two or more times, the number of times is entered in this column. The next column is for the dimension, and the third column, called the Squaring column, is for the products of the dimensions. For example, "twice 242 feet by 20 feet one-brick wall in mortar" would be written as shown above. Dimensions should always be written in the same order to facilitate reference, namely, length × width × height.

In taking off, system is of the utmost importance. There are three main systems, differing in the order of taking off. The first may be described as "taking off in trades," that is, each trade is taken off separately. This is a most laborious method, and is pretty well obsolete among practical surveyors, as items are likely to be overlooked; moreover, it makes future reference and consequently the adjustment of variations very tedious operations. On the other hand, it facilitates the work of the Abstractor, and indeed in some of the trades an abstract can often be dispensed with altogether. This, however, is not an important consideration, as the time of the "Taker-off" is much more valuable than that of the "Abstractor."

The second system consists in taking off each portion of the work complete in all trades. For instance, window openings are taken off complete, starting with the sashes and frames, glass and furniture, continuing with the deductions of brickwork, facings, plaster, and paper, and working up to the lintels, arches, sills, and finishings, such as architraves and window boards. This system saves time for the "Taker-off," greatly lessens liability to error, and facilitates the adjustment of variations at the completion of the job. On the other hand, it takes much longer to abstract.

Speaking generally, the most convenient system is probably the third—a modification of the last, the main difference being the separation of the carcase and finishings. This facilitates the subdivision of the work, and is particularly advantageous in a job where there is much variation in the character of the finishings, as these can be taken room by room. It also lessens the labour of abstracting, without rendering the adjustment of variations unduly difficult.

In large works, where several Takers-off have to be employed, the character of the building must decide

the easiest method of subdividing the work, and no hard-and-fast rule can be laid down.

The Taker-off should use plenty of headings on his dimension sheets, so that any item can be instantly located within a few sheets. In a large job, or one with much variation in the height of walls, it will be found advantageous to take off a wall at a time, under a proper heading, such as *North Wall of Main Building*. This will probably mean rather more dimensions, but these will be written down in less time than it takes to make big collections and think out the various additions for extra heights, besides which there is less liability to error, and much time is saved when it comes to adjusting variations at completion, making System No. 3 quite equal in this respect to System No. 2.

After giving briefly the order of the two systems Nos. 2 and 3, it is proposed to adopt the latter as being the more convenient for our purpose, and to explain the modes of measurement as far as possible in the order of that system, rather than deal with them under the various trades, as is done in most of the text-books. The student will thus be enabled to follow the subject through in the order in which the work is actually done, and each item will appear in its proper relation to that portion of the building to which it belongs.

The following list is not intended to comprise every possible item which a building might contain, but to give such an idea of the system that the student may readily be able to allot any item not mentioned to its proper place in the list:—

SYSTEM No. 2.

Preliminaries.
Surface digging.
Basement digging.
Basement trenches.
Concrete.
Footings.
Damp course.
Brickwork to G.F. level.
Surface trenches.
Concrete.
Footings.
Damp course.
Brickwork to G.F. level.
Remainder of brickwork.
Chimney breasts (starting with extra digging, concrete footings, etc. in the order given above).
Stacks.

Facings (commencing with stacks).

Brickwork in projections.
Extra for oversailing and moulded courses, cornices, etc.
Cement fillets and weatherings to ditto.
General facings.
Extra brickwork in plinth.
Extra width of damp course.
Extra for plinth course.
External rendering.
Rough cast.
Weather tiling, etc.

Drains (including digging).

Gulleys and setting.
Pipes and laying.
Bends.
Junctions.
Manholes.
Traps.
Ventilation
Testing.

Pavings.

Surface excavation for, and level and ram.
Brick rubbish.
Concrete.
Floated face.
Paving.

Mason.

Stone staircases, etc., complete, with handrail, balusters, etc.
Stone dressings (other than the ordinary stone sills and thresholds in brick openings), making the necessary deductions of brickwork at the same time.

Constructional Iron and Steel.

Floors.

Digging for sleeper walls.
Concrete for sleeper walls.
Footings for sleeper walls.
Damp course to sleeper walls.
Brickwork in sleeper walls.
Sleepers.
Plates.
Joists.
Concrete under floors.
Air bricks.
Rough oversailing for plates.
Plates for upper floors.
Joists for upper floors.
Deductions.
Trimmer joists.
Trimmers.
Herringbone strutting.

Roofs.

Fir plates.
Rough oversailing for plates.
Fir framed in roofs.
Fir framed in roof trusses.
Labour to rough chamfer.
Cleats.
Ends of timbers cut and pinned.
Templates.
Corbels.
Fir plates.
Ceiling joists.
Trap doors in ceiling complete.
Deduct plaster.
Add plaster quirk.

Slating or tiling } measured
Boarding } together.
Felt }

Allowance for double eaves course.
Tilting fillets.
Cuttings to slating or tiling.
Cuttings to boarding.
Ridges.
Hips.
Intersections of ridges and hips.
Valley boards.
Lead to valleys.
Valley fillets.
Gutter boards and bearers.
Short lengths of roll.
Short cross rebated drips and narrow risers.
Lead gutter.
Cesspools.
Lead to cesspools.
Extra labour and solder to cesspools.
Socket pipes.
Holes through brickwork for socket pipes.
Soakers.
Fixing soakers.
Flashings.
Rake out, wedge, and point flashings.
Step flashings.
Rake out, wedge, and point step flashings.
Fascia.
Eaves gutters.
Angles.
Stopped ends.
Outlets.
Wire covers to outlets.
Rainwater pipes.
Extra to swannecks.
Extra to plinth bends.
Extra to shoes.
Heads.
Beamfilling.

Chimney Stacks.

Deduct slating or tiling.
Deduct boarding.
Deduct felt.
Add slating or tiling for cuttings.
Add boarding for cuttings.
Deduct rafters.

Add for trimmer rafters.
Add for trimmers.
Gutter boards and bearers.
Short lengths of roll.
Gusset pieces.
Tilting fillets.
Lead in gutter.
Lead soakers.
Fixing only soakers.
Lead flashings.
Stepped flashings.
Lead apron.
Rake, wedge, and point flashings.
Rake, wedge, and point stepped flashings.

Skylights.

Deduct slating or tiling.
Deduct boarding.
Deduct felt.
Add slating or tiling for cuttings.
Add boarding for cuttings.
Deduct rafters.
Add for trimmer rafters.
Add trimmers.
Narrow gutter boards and bearers.
Tilting fillets.
Lead in gutter.
Lead flashings.
Copper nailing.
Curb.
Skylight.
Ironmongery.
Glazing.
Condensation sinkings.
Condensation holes.
Linings.
Shaft and backings (if any) complete.
Deduct plaster.
Plaster quirk.

Lantern Lights.

Deductions and additions of slating or tiling, boarding, felt, and roof timbers as to skylights.
Tilting fillets.
Lead flashings.
Copper nailing.
Curb.
Sill.
Angle posts.
Intermediate posts.
Head.
Casements fixed.
Casements to open.
Glazing.
Sets of cut beads.
Ironmongery.
Skylight.
Glazing.
Rolls.
Sinkings for condensation.
Holes for condensation.
Linings.
Deduct plaster.
Plaster quirk.

Dormers.

Deductions and additions of slating or tiling, boarding, felt, and roof timbers as to skylights.
Roof timbers of dormer.
Ridge, hips, slating or tiling, boarding and felt to roof of dormer.
Lead soaker.
Fixing soaker.
Valley boards.
Lead in valley.
Timbers in cheeks.
Boarding to cheeks.
Lead to cheeks.
Copper nailing.
Brass screws and soldered dots and sinkings in deal for ditto.
Lead tacks.
Soakers.
Fixing soakers.
Front apron.
Copper nailing.
Sashes and frames.
Glass.
Mouldings and cornices.
Mitres and fitted ends to mouldings and cornices.
Window boards.
Architraves.

Trap Doors.

Deductions and additions as to skylights, etc.
Curb.
Lead covering to curb
Copper nailing.
Narrow gutter boards and bearers.
Tilting fillets.
Lead to gutter.
Trap and rims.
Ironmongery.
Lead covering
Copper nailing.
Bossed angles.

Flats.

Rough oversailing
Fir plates.
Joists.
Boarding and firrings.
Drips.
Rolls.
Lead to flat.
Flashings.
Rake out, wedge, and point flashings.
Bossed ends to rolls.
Bossed intersections to rolls.
Bossed saddles to rolls.

Partitions.

Heads.
Sills.
Interties
Posts.
Braces.
Quarters.
Deductions.
Door heads.

Trussed Partitions.

Members of the truss, and remaining items as above.
Ironwork in straps and bolts.

Plastering and Paper.

Ceilings.
Ceilings sloping
Cornices.
External mitres.
Internal mitres.
Mitred and returned ends.
Fitted ends.
Walls.
Partitions.
Kene's cement angles.
Quirk.
Double quirk bead.
Fair point and twice lime-white.

Floors and Skirtings (beginning at the top floor).

Flooring.
Deductions.
Glued and mitred margins.
Flooring and bearers in openings.
Skirtings and grounds.
Rough rendering behind grounds.
External mitres.
Internal mitres.
Fitted or housed ends.

Fires.

Deduct brickwork.
Deduct plaster.
Deduct paper.
Rough relieving arch.
Chimney bar.
Render backs.
Stoves.
Setting stoves.
Chimney pieces.
Fixing chimney pieces.
Make good plaster around chimney pieces.
Feather-edged springer.
Trimmer arch and levelling up in concrete for hearth.
Centering to hearth, *or*
Digging.
Concrete.
Footings.
Fender walls.
Dry brick filling.
Concrete.
Hearth.
Back hearth.
Core and parge flues.
Chimney pots and setting.

Windows.

Sashes and frames.
Glass.
Furniture.
Horns.
Deduct brickwork in internal reveals.
Deduct plaster.
Deduct paper.
Lintel.
Relieving arch.
Linings.
Architraves.
Fixing fillets.
Window nosing.
Notched, mitred, and returned ends to nosing.
Grooves for nosing.

Deduct external brickwork in reveals.
Deduct facings.
Add facings for reveals.
Fair arch.
Deduct facings for arch.
Fair skewback cutting.
Fair circular cutting.
Centre or turning piece.
Stone sill.
Fair ends.
Stooled ends.
Ends cut and pinned.
Water bar.
Grooves for water bar.

External Doors.

Fanlight.
Glass.
Hinges.
Furniture.
Door.
Glass (if any).
Hinges.
Furniture.
Frame.
Dowels.
Mortices for dowels.
Bed and point frame.
Deduct brickwork in internal reveal.
Deduct plaster.
Deduct paper.
Lintel.
Relieving arch
Architrave.
Fixing fillets.
Deduct brickwork in external reveal.
Deduct facings.
Add facings reveals
Fair arch.
Deduct facings for arch.
Fair skewback cutting.
Fair circular cutting.
Turning piece or centering.
Step or threshold.
Fair ends.
Ends cut and pinned.

Internal Doors.

Door.
Glass (if any)
Hinges.
Furniture.
Linings.
Architraves.
Fixing fillets.
Deduct brickwork.
Deduct plaster.
Deduct paper.
Lintel.
Relieving arch.

Stairs.

Treads and risers.
Winders and risers.
Bull nose or curtail end.
Landing.
Wall string.
Wall string ramped.
Short ramps.
Heading joints.
Tongued and mitred angles.
Close outer string.
Ends framed on splay.
Steps housed to string.
Winders and risers housed to string.
Risers only housed to string.

Or,

Cut and mitred outer string.
Outer string wreathed.
Short lengths of rounded (or moulded) nosing, tongued and mitred to treads and returned at one end.
Cut Brackets.

Newels.
Turnings to newels.
Treads notched and fitted to newels.
Risers housed to newels.
Winders notched and fitted to newels.
Risers to winders housed.
Handrail.
Handrail ramped.
Handrail wreathed.
Ends framed to newels.
Ends framed on splay.
Ends plugged to wall, and plaster made good.
Balusters.
Tongued and rounded nosings.
Groove for nosings.
Fitted ends.
Apron linings.
Fitted ends.
Fitted ends on splay.
Plaster quirk.
Lath, plaster, float, and set soffites.
Lath, plaster, float, and set soffites flueing.
Plaster quirk.

Spandril Framing.

Framing and backings
Scribing (if any).
Extra for door.
Rebate.
Bead.
Hinges.
Locks and furniture.

Fittings.

Shelves and bearers.
Shelves cross-tongued.
Ship lap joints.
Cupboard front.
Doors.
Hinges.
Furniture.
Ends.
Top and bearers.
Shelves and bearers.
Quadrant corner.
Scribing.
Cornice.
Mitres.
Fitted ends.
Mitred and returned ends.
Dresser.
Wood sinks.
Attendance.
Bearers to sinks.
Lead lining.
Soldered angle.
Copper nailing.
Brass washer and waste and joints.
Brass plug and chain
Lead trap.
Lead waste.
Hole through wall, and making good.
Enclosure underneath.
Hinges.
Fastenings and furniture.
Deal top.
Draining board.
Stoneware sinks.
Attendance.
Bearers.
Brass washer and waste and cobweb grating and joint.
Trap and joints.
Lead wastes.
Holes through walls, and making good.
Wall tiling or cement around sink.
Draining board.

Lavatories.

Basins complete with valves and wastes.
Attendance.
Cast-iron underframes or deal framed bearers.
Traps and joints.
Lead wastes.
Lead overflow.
Lead vent pipe.
Wire balloon covers.
Lead antisiphonage pipe.
Branch joints as they occur.
Holes through wall, and making good.
Enclosures complete as to sinks.

Baths.

Bath complete with valves and waste.
Deal cradle (if bath is enclosed).
Trap and joints.
Lead waste.
Lead overflow.
Lead vent pipe if required.
Wire balloon covers.
Branch joints as they occur.
Hole through wall, and making good.
Lead safe.
Bossed corners.
Dished hole.
Short length of warning pipe and joint, including hole through wall and making good.
Copper flap.
Bath top.
Skirting.
Mitres.
Returned ends.
Enclosure.
Extra for doors in enclosure.
Ironmongery.
Joiner attend Plumber to bath.

Joiner attend Plumber to safe.

Water Closets.

Apparatus complete, including fixing and joints to pipes.
Attendance.
Soil pipe, including joints, tacks, and fixing.
Bends.
Branch joints.
Hood and straps or wire balloon cover.
Hole through wall, and making good.
Brass ferrule and joints.
Antisiphonage pipe.
Bends.
Branch joints.
Holes through wall, and making good.
Lead safe, etc., as to bath.

To Valve closets only.
- Seat and riser and bearers.
- Flap and frame.
- Butts.
- Hole cut and dished for pan.
- Hole cut and dished for handle.
- Skirting and backings.
- Mitres.
- Returned ends.

Water wash preventer complete, with ball valve and unions and joints to flushing and overflow pipe, and including brackets and fixing and chain and pull.
Attendance.
Overflow pipe, including hole through wall and making good.
Flushing pipe, including tacks and fixing.
Bends.
Canvas and putty joint.
Brass clips and rubber buffers.
Paper boxes.

Water Supply.

Cisterns and bearers.
Attendance.
Enclosures (if any).
Covers and ironmongery.
Hole through enclosure.
Drilling cistern.
Brass union and fly nut, with screw cap and lining and joints.
Lead overflow.
Holes through roof, including lead slate and tafted soldered joint, and making good.
Brass back flap.
Opening up roadway, tapping main and fixing ferrule, and making good to approval of authorities.
Supply pipe and laying in rough deal trough and covering with pitch.
Supply pipe, including narrow trench and covering with pitch and filling in and ramming.
Rising main, including tacks or wall hooks and fixing.
Holes through floors, etc., and making good.
Hole through enclosure.
Drilling cistern.
Ball valve and union and joints to cistern and pipe.
Stop cock and cast-iron box in pavement.
Stop cock on rising main.
Short length of ½-in. pipe and ½-in. bib cock, and all joints to empty rising main.
Branch or branches from rising main to draw offs.
Soldered branch joints.
Soldered dead ends.
Brass bib cocks and joints.
Hole through enclosure.
Drilling cistern.
Brass union with fly nut and screw cap and lining and joints.
Service pipe.
Holes through floors, etc., as they occur.
Soldered dead end.
Brass bib cock and joints.
Branches from main service pipe.
Soldered branch joints.
Soldered dead ends.
Brass bib cocks and joints.

Hot-water Service.

Cylinder.
Lead supply pipe.
Brass screw union with screw cap and lining and joints.
Brass stop cock
Flow and return pipes between boiler and cylinder.
Bolted and flanged connection to boiler.
Bolted and flanged connection to cylinder.
Bolted and flanged connection in cylinder for flow and return pipes.
Flow and return pipe from cylinder, including all bends and joints T's, +'s, etc., and fixing complete with wall hooks.
Auxiliary flow pipe.
Steam pipe.
Hole through roof, lead slate, and tafted joint, and making good.
Branch pipes.
Bib cocks and joints.
Attend upon, cut away for, and make good after hot-water engineer in all trades.

Gasfitter.

Pay company for opening up roadway and connecting up from main to front wall of premises, including stop cock and key, and cast-iron box in pavement, and making all good.
Meter.
Shelf or enclosure.
Short length of compo pipe and connections to meter.
Stop cock and loose spanner.
Pipes, including all joints, bends, elbows, T's, etc., and fixing.
Attend upon, cut away for, and make good after gasfitter in all trades.
P.c. for fittings (enumerating them), and add profit, carriage, and fixing.

Bellhanger.

Bells.
Pulls.
Bellboards.
Attendance in all trades as last.

Electric Bells.

Bells.
Pulls.
Indicators.
Switches.
Attendance in all trades as last.

Painting.

System No. 3 differs from System No. 2 in generally separating the carcase and finishings, so that the only alterations to the foregoing list will consist in removing the sashes and frames, window boards, architraves, and plastering from the "Dormers" and placing them under the heading of "Windows," and removing all except the above items from the headings "Windows," "External doors" and "Internal doors," and placing them under new headings of "Window openings," "External door openings," and "Internal door openings," to be inserted immediately after "Facings" in the foregoing list.

In the two following chapters the modes of measurement will be given in the order, generally, of System No. 3. They will be found to include most of the ordinary items comprised in a domestic building, from which the student may acquire a knowledge of general principles capable of further application; to attempt more than this is beyond the scope of the present work, —indeed, the most exhaustive treatise can but supplement, it cannot supplant, that experience which can only be gained in the office of a competent Surveyor.

CHAPTER III

QUANTITIES: TAKING-OFF CARCASE

(Contributed by W. H. Brown, F.S.I.)

The dimensions should be started by notes of the "Preliminaries." These will consist of such items (some of them contained in the Conditions) as either have a direct monetary value or will indirectly affect the price, such as fees, taking up stacking and relaying paving, shoring to adjoining premises, etc. Any new party walls or work to existing ones should be kept separate.

Surface Digging *is measured per foot super.* up to 12 inches deep, stating in the Description if it includes the separation of vegetable soil. Over 12 inches deep it is measured per foot cube, the separation of vegetable soil being separately measured, and is *billed in yards cube.*

Basement Digging, *per foot cube*, divided into depths of 6 feet and kept separate, as "not exceeding 6 feet deep," "exceeding 6 but not exceeding 12 feet deep," etc., 6 feet being known as "one throw"; that is, the height which one man can throw. A staging is required at each 6 feet of depth. State if earth is basketed out (as required in confined situations), if wheeled, and how many runs (one run is 20 yards), if deposited on site or carted away. If the excavation is to include grubbing up old foundations, state it. Taking up old pavings may be included with Surface Digging if measured super., otherwise it should be separately measured. The space between outer face of wall and face of digging to be separately measured, and deducted from the digging and carting away, and added to "Excavation to basement not exceeding 6 feet deep (or as the case may be), and return, fill in, and ram around walls." *Billed in yards cube.* State in the Preamble to the Bill that all digging includes any necessary planking and strutting, or measure it per foot run; describe it as to sides of excavation, and state the depth. If it is doubtful whether planking and strutting will be required, mark it "Provisional," and deduct at completion if not required.

Trenches are *measured per foot cube.* Keep basement trenches separate, and state their depth below ground level. Measure the whole of the trench as "Excavation to basement trenches, and return, fill in, and ram around foundations"; then measure the space occupied by the wall, footings, and concrete, deduct it from the previous item, and add it to "Excavation to surface trenches, basket out and cart away" (or as the case may be). *Billed in yards cube.* Where planking and strutting is not provided for in the Preamble, measure it the length of the trench, describe it as "To trenches one side measured," and state depth and width of trench.

Excavation in Underpinning is kept separate, and described as "In short lengths in underpinning, and to include all planking and strutting and soldiering, and strutting off face of brickwork as it is built"; or the planking and strutting may be *measured separately per foot run.* Measure both sides of trench, one end and one division for each bay (*i.e.* each length in which the underpinning is done), describe it as "all measured," and state width and depth of trench; also state that it includes soldiering and strutting off face of brickwork as it is built, and remember to measure the trench wide

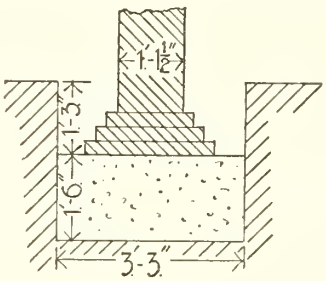


Fig. 23.

enough to allow working space for the Bricklayers. A reasonable allowance would be a clear 3 feet from the finished face of brickwork to the front edge of excavation. It is much fairer in work of this kind to measure the planking and strutting separately as above, because it is quite impossible to estimate the quantity simply from the cubic quantity of excavation. It may be marked "Provisional," and remeasured as executed, and adjusted at completion.

Measure the filling in behind wall *per foot cube, and bill in yards.* This is best done in rough concrete; one of cement to 12 of ballast will be quite good enough. If earth is filled in here it is quite impossible to ram it.

Concrete. — *Measure per foot cube and bill in yards.* The series of items for Trenches and Concrete for a 20-foot length of trench as Fig. 23 will be as follows:—

20.0 3·3 2.9	Exc. surf. trs., and R., F. and R.[1]
20.0 1.1½ 0.6	Ddt. do. do.
	and
20.0 1.10½ 0.9	Add. exc. surf. trs. a.b., basket out and c.a.
20.0 3·3 1.6	
20.0 3·3 1.6	P.c. conc. as descr. in founds.

Keep concrete in underpinning separate, and state that it is in short lengths.

Where the concrete foundations are stepped, take shutterings to the ends. These should be numbered and their size stated.

Brickwork is now usually measured including all rough cutting, and no objection can be urged against this in ordinary works; but where there is an unusual amount of rough cutting it seems more reasonable to measure it. It is *measured per foot run* under 6 inches wide, *and per foot super.* over 6 inches. Fair cutting is *measured per foot run*, and is understood to cover a depth of 4½ inches. Anything beyond this depth should be *measured per foot super.* as rough cutting. For example, a 20-feet length of 14-inch brick gable surmounted by a coping would have 20 feet of fair raking cutting, billed under "Facings," and 20 feet by 9 inches of rough splay cutting.

Footings.—*Measured per foot super.*, the length by the height, and their average thickness stated in terms of a brick. Thus in a 1½-brick wall with three courses of footings the top course will be 2 bricks and the bottom course 3 bricks thick, or an average of 2½ bricks. *Billed with reduced brickwork in rods.*

Damp Course.—*Measure and bill per foot super.*

Vertical Damp Course.—Measure and bill per foot super., and state that it includes extra labour and cutting to angles.

Brick Walling is *measured per foot super.* and the thickness stated in terms of a brick. No notice is taken at this stage of the work of any offsets for floors, extra thickness for plinths, etc. These are added later on. Measure the external walls first, and then the internal walls, either by collecting all of same thickness or a wall at a time. Brickwork over 60 feet above ground to be kept separate; all above that height divided into heights of 20 feet. One-brick walls built fair both sides should be kept separate. Half-brick partitions and sleeper walls must be kept separate and *not* reduced.

Hollow Walls are measured solid their full thickness, including the cavity, and reduced. State the respective thicknesses of the two portions and the width of cavity. Give the description and the number per yard super. of the ties, and state if haybands are to be placed in cavity and drawn up as the work proceeds, or other precautions taken to arrest falling rubbish. Remember, when deducting the openings in hollow walls, to notice if a strip of lead built into brick joint and bent as gutter over the opening, or any other method is specified, to carry water clear of the frames.

Brickwork Circular on Plan is kept separate. State the radius, and that it includes templates. If under 25 feet radius, state that it includes any necessary cutting.

Breasts.—Having measured all the common brickwork (except garden and fence walls, which may be conveniently measured all together as the last item under common brickwork), start with the chimney breasts, taking one at a time, following each up through the various floors and finishing with the stack, which latter is measured as solid, making no deduction for flues. Take no notice at this stage of any projections on stacks for caps, etc. Start with the extra digging,

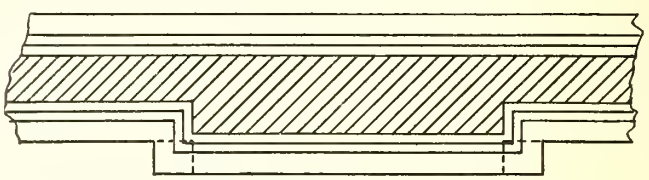


Fig. 24.

and follow the order of the list. Note that the extra width of trench, concrete footings, and damp course, and the extra thickness of breast, will all be the same, the lengths only varying with the spread of the foundations. Nearly the whole of the extra digging will be carted away, the portion filled in and rammed having previously been measured with the general walling, with the exception of the small portions above the concrete and footings at ends of breast, indicated by dotted lines on Fig. 24.

Take Rough Rendering outsides of flues against floors and roofs as they occur. *These are numbered.*

Battering Walls are kept separate. State the amount of batter. If one face only batters, measure as

[1] Abbreviations are largely used by the Taker-off, most of them being obvious and well recognised. Thus "R., F. and R." means "Return, Fill and Ram"; while "a.b." means "as before," and "c.a." means "cart away."

common brickwork, and take a super. dimension of extra for battering face, stating the batter. Include templates.

Vaulting.—*Measured per foot super.*, the length by the mean girth (see Fig. 25). State the thickness and *bill as reduced brickwork in vaulting*, and fully describe, —as, for example, "In two half-brick rings in cement."

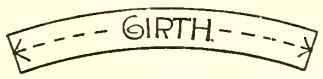


Fig. 25.

Groin Point.—*Measured per foot run.* Describe as labour and waste to groin point of vaulting, and state thickness of vault.

Centering to Vaulting.—*Measure per foot super. and bill in squares.* State that it includes horsing, and the height of same. If it is groined, keep it separate and state it, and measure the groin point per foot run as extra for groin point, including raking, cutting, and waste, and write this short in the Bill.

Brickwork in Backing to stone is kept separate, and cutting and bonding to stone included in the description.

Brickwork in Cement in Underpinning is kept separate, and described as in small quantities. State that it is to include any head pinning required, and all shoring.

Take Caulking in cement and sand (1 to 1), mixed stiff *per foot run*, and state thickness of wall. This is taken to the joint between the top of underpinning and the old wall. This is the practical way of carrying out the oft specified "wedging up in slates and cement," and makes a much sounder job.

Brickwork (usually in cement) in Filling up old Openings is kept separate, measured wide enough to allow for bonding, and described in small quantities. It should include cutting and bonding to old work in the description, or the cutting and bonding may be *separately measured per foot run*, and the thickness of wall stated.

Brickwork in Raising on old Wall should be kept separate.

Prepare Top of Old Wall to receive New, *measured per foot run*, and thickness of wall stated. If the top courses are taken down, include this in the description, stating how many courses.

Draw, Tooth, and Bond is *measured per foot super.* State that it includes extra materials.

End of New Wall cut and bonded to Old is *measured per foot run.* State the thickness of wall. The extra brickwork required for the bonding should be measured with the new walling.

Facings.—*Measured per foot super.* as extra on common brickwork, commencing with the stacks, and completing them with their cappings, plinths, etc. Next measure the general facings to 3 inches below ground line, and allow $2\frac{1}{4}$ inches in the length for each internal angle for bonding. Take a wall at a time or collect, whichever is more convenient.

Note.—When it is intended to measure all extras under "Facings" as extras on common brickwork (and this is by far the better plan), much repetition may be saved by stating it in a note immediately under the heading in the Bill.

Cornices.—Measure the projections of cornices, etc., their length by the mean projection, as common brickwork, and deduct the facings behind them; then measure the cornices per foot run as extra on common brickwork, and fully describe, giving their height and projection. If in short lengths, state it. Number the mitres, fitted ends, mitred and returned ends, etc., which should be "written short" in the Bill.

Oversailing Courses of Facings.—Measure the projections as common brickwork, and deduct the facings behind them; then measure the oversailing courses *per foot run* as "extra on common brickwork," stating the number of courses in height, the total projection and if set back over, include "pointing to match facings." If any course consists of all headers, state it. Square angles may be included in the description.

Chimney Cappings may be *numbered* and fully described, stating the length and thickness of stack; and, as the work is in short lengths with many mitres, this method will perhaps convey to the Builder as good if not a better idea of its value than the more detailed one.

Cement Weatherings and Fillets.—*Measure these per foot run* immediately after the cornices or mouldings on which they occur. Include the mitres, etc.

Plinth.—*Measure* the projection for plinth *per foot super.*, stating its thickness in terms of a brick, as $\frac{1}{8}$ B. or $\frac{1}{4}$ B., as the case may be, as common brickwork. *Measure* and describe the plinth course *per foot run* as extra on common brickwork, deduct the facings behind, and *number* the mitres, fitted ends, mitred and returned ends, etc.

Note.—Measure all plinths, pilasters, etc., projecting less than half-brick per foot super. as "Extra labour building brickwork in $\frac{1}{4}$-brick projections in plinths, pilasters, etc. (or as the case may be), including all cutting."

Damp Course.—Measure here the extra width of damp course in projection for plinth.

Fitting and Bonding Superior Facings to Common Facings.—*Measured per foot run* for labour.

Fitting and Bonding New Facings to Old.—Measured similarly to the last item, an allowance being made for extra materials when measuring the facings.

Quoins, Bands, etc.—Where the quoins, bands, etc. only are in superior facings the width of the quoins should be averaged to include the bonding, and described as "In small quantities in quoins, bands, etc.," and a lineal dimension taken, as previously explained, for labour fitting and bonding.

External Rendering, Rough Cast, Weather Tiling, or any external covering to walls (except stone facings) should next be measured.

Cement Rendering.—*Measure per foot super.* and *bill in yards*, and fully describe as to number of coats and kind of finish. Keep narrow widths (under 2 feet wide) separate, and *bill them in feet super.* If on laths, as to external partitions, state that it is "on and including lathing," and describe laths, whether "lath and half" or "double lath," "fir split laths," or as the case may be.

Counterlathing, *per foot super.* If in narrow widths, as it usually is, state it.

Arris.—*Measure* labour to arris *per foot run.* Arris and reveal not exceeding 9 inches wide may be measured together per foot run as "arris and 6-inch return," or as the case may be.

Where edge of rendering stops against brick or stone, take a lineal dimension of the labour of fitting edge against brick or stone, as the case may be.

Rustic Grooves, *per foot run.* State width and depth, and remember to measure the plain face between the grooves in narrow widths.

Cement String Courses, *per foot run.* State width and thickness, and include weathering, arrises, etc. If more than 1 inch thick, include dubbing out in the description.

Mouldings and Cornices exceeding 12 inches girth are measured *per foot super.* Take the length by the girth. Those not exceeding 12 inches girth are measured per foot run, and the girth stated.

Rough Oversailing Courses as core for cornice. Measure as described on page 64.

Stone Core *per foot run*, and state size.

Mitres to Cornice.—*Number.* State girth of cornice, or write them short, and keep internal and external mitres separate. Keep irregular mitres separate.

Mitred and Returned Ends.—*As described to mitres.*

Fitting rendering or plastering, around pipes, projecting rafter feet, etc.—*Number.*

Rough Cast.—Measure generally as described to external rendering in cement. The full description should appear immediately under the heading. There will be no "arris" to measure under Rough Cast, for although all angles of course entail an extra labour this may be included in the description.

The remaining labours, etc., will be measured as described under "External Rendering."

Vertical Tiling.—*Measure per foot super.*, and *bill in squares.* Give full description, and state the gauge and how secured. Include the battens, giving their size, and state if plugged. If there are bands of ornamental tiles, state it, describing them, and what proportion they bear to the plain. The full description should be given in the Preamble. The description in the *Bill* will then be as follows:—

Squares 30	Sup.	Plain and ornamental tiling as described, in the proportion of $\frac{2}{3}$ plain and $\frac{1}{3}$ ornamental, in alternate bands, fixed vertically to a $3\frac{1}{2}$" gauge, with two $1\frac{1}{2}$" zinc nails to each tile, on and including $\frac{3}{4}$" × $2\frac{1}{2}$" sawn fir battens, plugged to brickwork.

Cuttings.—Make the same allowances as to roof tiling.

Angle Tiles.—*Measure per foot run* as "extra for angle tiles to course, and bond with the general tiling."

Fireplace Openings

Deduct the brickwork for opening.

Chimney Bar.—*Measure per foot run*, and state size. Weigh out on abstract, and *bill in cwts.*

Relieving Arch.—*Number* as "Extra labour, cutting and waste to rough segmental relieving arch." State whether in mortar or cement, and the height, width of soffite, and span.

Render Chimney Back.—*Number*, and state kind of mortar.

Stoves.—Usually a *provisional sum.* State the number of stoves, and that the contractor must add for carriage and profit.

Setting Stoves.—*Number*, and the kind of stove stated.

Setting Ranges.—*Number*, and the kind of ranges stated.

Chimney-pieces.—Usually a *provisional sum* is given for these. State the number and kind (whether wood, iron, etc.), and that the contractor must add for profit, carriage, and fixing. Simple kinds of wood or other chimney-pieces intended to be made by the contractor may be *numbered* and described, and sketch given.

In the case of ordinary kitchen chimney-pieces, with stone or cement jambs and mantels and wood shelf, the simplest way is to *number* the sets of jambs and mantel, and fully describe, stating sizes of parts and width and height of opening. *Number* and describe the shelf and bearers, or *measure it per foot run*, and *number* the returned ends, rounded corners, etc.; also the wrought and cut bearers, including cutting and pinning in.

Next measure the Fender Walls (to ground floor fireplaces), with their digging, concrete footings, etc., as previously explained.

If to upper floors:—

Feather-Edged Springer.—*Measure per foot run.*

Trimmer Arch and Levelling up in Concrete.—*Measure per foot super.*

Centering to Trimmer Arch *per foot super.* State if left in for lathing-to. If not, take Filleting to Soffite *per foot super.*

Dry Brick Filling.—*Measure per foot cube* for filling up under concrete for ground-floor hearths.

Concrete (under ground-floor hearths) *per foot super.*

Floated Face on concrete for tile hearth *per foot super.*

Hearths and Back Hearths (Stone).—*Measure per foot super.*, and describe. State thickness, and that they include jointed edges. If front and back hearths are in one piece, *measure the notchings per foot run.*

Hearths and Back Hearths (Cement).—*Measure per foot super.* and *bill in yards.* State thickness, kind of cement and proportions in which it is mixed, and how finished.

Hearths and Back Hearths (Tile).—*Measure per foot super.* and *bill in yards*, and give p.c. price of the tiles, and describe how laid. Measure cutting and waste to edges (where the tiles have to be cut). Keep raking cutting separate. *Measure* any Border of smaller tile *per foot run.*

Core and Parge Flues.—*Number* these, and state their average length.

Chimney Pots and Setting and Flaunching in Cement.—*Number* these, and state their p.c value.

Window Openings

Deduct Brickwork in External Reveals, the width by the height from top of stone sill to head.

Deduct Facings, same dimensions as last.

Add Facings for reveals the width by the height of reveals.

Arch (Brick).—*Measure per foot super.* as extra only on common brickwork. Take the height of the voussoirs by the mean length between the intrados and extrados; then take the soffite, its width by its length.

Deduct Facings (for Arch).—Take the same dimensions as for the face of the arch.

Fair Skewback Cutting.—*Measure per foot run.*

Fair Circular Cutting.—*Measure per foot run.*

Centering or Turning-piece.—*Measure per foot super.* to soffites exceeding 9 inches, and *per foot run* to those not exceeding 9 inches in width. State the kind of soffite, whether segmental, semicircular, etc.; and that it includes the necessary strutting. Keep centering to gauged arches separate, and describe it as close boarded.

Stone Sill.—*Measure per foot run*, and describe all the labours upon it. If in scantling lengths, state it.

Jointed Ends.—Where the sill is not in one length take two jointed ends for each joint. *These are numbered.*

Fair Ends or Fair Returned Ends, as the case may be. *These are numbered.*

Stooled Ends.—*Number.*

Ends Cut and Pinned.—*Number* and *bill under the Facings.*

Frames Bedded and Pointed.—*Numbered*, and materials described. Frames over 24 feet super. are called large; over 36 feet super., extra large.

Deduct Brickwork of Internal Reveal.—For double hung sashes add 9 inches to the width and 3 inches to the height, and for solid frames add $4\frac{1}{2}$ inches to the width and 3 inches to the height of the deduction of external reveals.

Lintel (Wood).—*Measure per foot cube.*

Rough Relieving Arch.—*Number*, and describe as "Extra labour, cutting and waste" to rough segmental (or as the case may be) relieving arch, stating the height, width of soffite, and clear span. These may be averaged on the Abstract.

Fixing Fillets or Wood Bricks.—*Number*, state the size, and that they include building-in; or the fillets may be billed in the Carpenter and building-in separately billed in the Bricklayer.

External Door Openings

The items under this heading will be the same as to window openings, and the same remarks will apply; except that in the place of the window sill and weather bar there will be a step or threshold.

Stone Step or Threshold.—*Measure per foot run*, and describe, giving height and width. If in scantling lengths, state it; state if tooled or rubbed, and whether on top face or top and front faces, and if back jointed.

Jointed Ends . . .
Fair Ends . . . . } Take as explained for window sills.
Ends Cut and Pinned

Internal Door Openings

The remarks as to "Window" and "External door openings" will apply generally, and the same order should be followed, with the following exceptions:—

There will be no stone step, and no fair arch in any ordinary opening. There will be a lintel the full thickness of the wall, with or without a rough relieving arch over.

As the internal doors are usually hung to linings there will be no check for frame, and consequently the deduction of the full thickness of the wall will be made in one operation. There will be no item of "Bed and point."

Drains (*including digging, and laying and filling-in and ramming*)

Gulleys.—Start with the gulleys, *which are numbered*, and state that they include bedding in concrete and connecting to drain.

Drains.—Take the branch drains from the various gulleys *per foot run*, and state the average depth of digging, and describe method of laying and jointing, and whether it includes a concrete bed, and if covered in all round with concrete, and state the least thickness of such concrete. Any length under 2 feet must be measured as 2 feet.

Bends and Junctions.—*Number and describe* as "Extra for 4-inch bends" or "4 to 6-inch junctions," or as the case may be, they having been previously included in the measurement of drains.

Diminishing Pieces.—*Number* and give both diameters, as, *e.g.*, "Extra for 4 to 6-inch diminishing piece."

Having taken the branch drains, proceed with main drain in a similar manner.

Manholes.—Take these as they occur. They may be *numbered* and fully described, including the channel pipes and bends complete, giving the clear internal dimensions and a line sketch plan, to show the number and arrangement of the channel pipes and bends, as shown in Fig. 26.

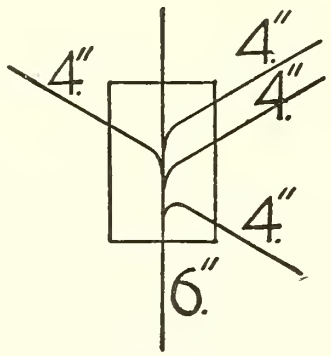


Fig. 26.

The holes for pipes and making good, including cover stones, may be included in the description, *or* the manholes may be *measured in detail* and *billed all together* under a separate subheading such as—

The following is in No. Manholes.

Manhole Covers and Frames.—*Number* these and give their p.c. value, and state that they include fixing.

Foot-Irons.—*Number* and describe, and include the building-in.

Disconnecting Traps.—*Number* and describe, stating their p.c. value, and include hole in wall of manhole, and cover stone and making good.

Ventilating Pipe.—*Number* the short lengths of heavy galvanised cast-iron ventilating pipes, stating their length, and include joint to drain.

Fresh-Air Inlet Ventilators.—*Number* and give their p.c. value, or quote the makers and catalogue number. State that they include joints to galvanised iron pipe. Measure and bill with the drains any stoneware pipe leading from manhole to vent pipe. If fixed vertically, state it. *Number* the bends, etc. *Number* the holes in walls of manhole and making good.

Lamp Holes.—*Number* and describe. Include the covers and frames, or *number* these separately, and include the fixing.

Connection with Sewer.—*Number*. The description to include opening up roadway and pavement for drain, and making good afterwards to the satisfaction of the local authorities, or pay them for doing the work; and pay all fees.

Make an item of testing drains in the presence of the architect, making good all defects and leaving all perfect. State method of testing, and if to be tested both before and after covering in.

Pavings.—First measure the surface excavation (if any), and the level and ram, *per foot super.*, and *bill in yards.*

Brick Rubbish (if any).—*Measure per foot super.* State the thickness and *bill in yards.*

Concrete, as last.

Floated Face, taken under tile and mosaic pavings and wood block floors, is *measured per foot super.* and *billed in yards*, and the thickness stated.

Cement or Granolithic Paving.—Measured as last, and described; or they may be included in the description of the concrete, especially the granolithic, as this should be done while the concrete is still green.

Brick Paving.—*Measure per foot super.*, and *bill in yards.*

Measure raking cutting and waste to all raking edges.

Tile Paving.—*Measure per foot super.*, and *bill in yards.* If the tiles are laid square let such dimension be a multiple of the size of the tile, and measure cutting and waste *per foot run* around voids (if not an exact multiple of the tiles), and to raking edges only. If tiles are laid diagonally, or in any way to require cutting to all edges, take it.

Asphalt Paving *per yard super.* State thickness and fully describe.

Skirtings to Asphalt Paving *per foot run*, and include angle fillet in the description. *Number* the mitres, fitted ends, etc.

Channel formed in Pavings.—*Measure per foot run*, and *number* the rounded and stopped ends.

Fitting Pavings around gulleys, manhole covers, etc.; *number.*

Fitting and Dishing, cement, granolithic, or asphalt pavings to gulleys. *Number.*

MASON

All stonework, except steps and thresholds and ordinary sills and heads, such as are usually measured at the time of deducting the brick openings, may be conveniently measured now.

There are two principal methods of measuring stonework. One is to measure the stone and labour together *per foot cube*, splitting it up into parts on which the labours are similar, and fully describing them and giving sketches of the more ornate parts.

The other method is to measure the stone *per foot cube*, and measure all the labours on it separately *per foot run* or *per foot super.* according to their width or girth. Under this system great uncertainty formerly prevailed as to what extent preliminary labours had

been measured, as there was no uniformity of practice in this respect.

In modern practice the second method has been modified to the extent of eliminating the preparatory labours, so that all finished faces include these; it has also become customary to include *plain* beds and joints with the cube stone, and hoisting and setting also. Whichever system is adopted, it should be clearly stated at the end of the Preamble.

The modes of measurement will be given here which are applicable under the system in which the following clause occurs in the Preamble to the Mason's Bill: "All finished surfaces to include preparatory labours," but first of all the following exceptions must be particularly noticed:—

1st. Plain Face must be measured to all four faces of mullions of their full width, no deduction being made for any subsequent labour of moulding or chamfer.

2nd. Plain Face must be measured to both faces of stone in tracery heads when these are measured in detail; but this is rarely done now.

With the above exceptions, whenever a superior labour is measured over any portion of a face previously measured, deduct the previous labour on that portion.

"Rough Sunk Work," although really a preparatory face, is always measured where it occurs, notwithstanding the note as to preparatory faces being included; and for the reason, that in a given quantity of "sunk face," rough sunk work may or may not be a necessary preliminary, and so if it were not measured there would be two possible values to "sunk face."

Stone.—The London practice is to measure this net, and a note to that effect must be inserted in the Preamble. It is *measured per foot cube*, the net size of the smallest cube out of which the stone could be cut. Even in the case of triangular stones where a saving might be effected by cutting two pieces out of one block it is not usual to take it so, but if it is done it must be clearly stated. Include and describe the hoisting and setting up to 40 feet high with the stone. Keep any above that height separate, and divide it into heights of 20 feet. Keep stone in scantling lengths (this varies with the kind of stone, for Portland it is 6 feet) separate.

When any labour cannot be worked in a length right through the stone it is kept separate and described as stopped. A rebate, however, is not described as stopped on account of the angle in it, unless the rebate finish with a return end.

Work in Small Quantities.—To be kept separate, and described as such.

Labours in Short Lenghts, say 9 inches and under, to be kept separate, and described as such.

Joggle Joint.—*Measure per foot run.*

Cramps, Dowels, Plugs, etc.—These are *numbered* and described. In the case of cramps, state their weight, and include the sinkings or mortices and running with lead.

Sawing, although never measured now, must be explained, in order that the method of measuring the labours to backs, beds, and joints may be understood. In sawing a long block into two or more stones, each cut provides two sawn faces, and the labour to each of those faces is known as "half-sawing."

Labour to Back.—The back of a stone may be merely the quarry face, or it may be sawn; and in either case it may require a little extra labour on it. This is described as "labour to back," and includes the half-sawing (if any).

Plain Beds and Joints.—The top and bottom of the stone, as it is placed in the wall, with stones or brickwork above and below it, will, in addition to "half sawing," require a little extra labour to be expended on it in order to produce an even bed, and the entire labour, including the half-sawing, is called "half-bed." A similar labour to the end is called half-joint. These labours are measured the full size of the top, bottom, and end faces of the true cube. Beds and joints are billed together, and if each face is measured, the amount must be divided by 2 on the Abstract, and billed as "plain beds and joints"; *or*, in the case of a stone in the middle of a wall, one bed and one joint may be measured instead of two half-beds and two half-joints. Note that in the case of granite the beds and joints are "all measured"; that is, a full bed or joint is measured to *each* face instead of a half-bed or joint as to other stones.

Sunk Beds and Joints are *measured per foot super.* to any bed or joint "out of square," or sunk below the general surface of a true cube. Notice that this is all measured; that is to say, that each surface so measured is a sunk bed or joint, and not a sunk *half*-bed or joint.

Circular Beds and Joints.—*Measure per foot super.*, and "all measured." There are convex or concave beds and joints, such as to the extrados or soffite of a relieving arch.

Circular Sunk Joint.—*Measure per foot super.*, and "all measured," to joints which are sunk below the surface of a circular face, such as a rebate for frame in the soffite of an arch. If stopped, keep it separate.

Plain Work or Plain Face.—*Measure per foot super.* to all plain surfaces exposed to view, and the kind of finish stated in the description. Plain work under 3 inches wide is *measured per foot run* and the width stated. If stopped, keep it separate.

Sunk Work or Sunk Face is plain face worked below the original face of the stone, and is *measured per foot super.* if over 3 inches wide or girth, and *per foot run* if less, stating the width or girth and the kind of sinking, as rebate, groove, etc. If stopped, keep it separate.

Mitres to Sunk Work.—*Measure per foot run or number*, and give the average length, and describe the nature of the sunk work as "splay," or as the case may be.

Stops.—*Number* and describe and state girth.

Rough Sunk Work, measured *per foot super.*, is taken in addition to any labour of greater value than bed or joint which has to be finished 3 inches or more below the original surface of the cube. For example (see Fig. 27), if the distance DB is 3 inches or more, rough sunk work must be measured, but the dimension for this will vary according as the distance EC is or is not less than 3 inches. If EC be less than 3 inches the dimension will be the length of the stone by the width AB. If EC be 3 inches or more the dimension will be the length of the stone by the girth AC and CB.

Moulded Face.—*Measure per foot super.*, the length by the girth of the moulding, if over 6 inches girth. *Measure per foot run*, and state the girth if 6 inches girth or less. In measuring mouldings, take their length along the extreme projection.

Mitres are *numbered* and the girth stated.

Where the moulding is *measured per foot run* the mitres may be written short.*

Stops.—*Number* and describe and state the girth. These may be written short where the moulding is taken *per foot run*.

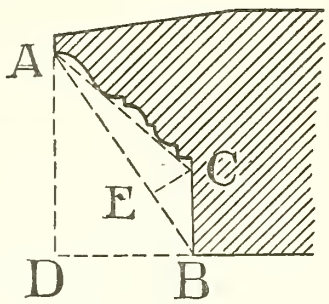


Fig. 27.

Circular Moulded Face is measured as described to "moulded face," also its mitres and stops.

Circular Work.—*Measure per foot super.* to plain *convex* surfaces. If stopped, keep it separate.

Mitres and Stops.—Measured as to sunk work.

Circular Work Sunk.—*Measure per foot super.* to all *concave* surfaces; also to such work as the shafts of diminishing columns. If with "entasis," state it. If stopped, state it.

Mitres and Stops as described to Sunk work.

Circular Circular Work.—*Measure per foot super.*

* The term "Written short" is applied where mitres and other numbered labours directly follow the lineal dimension of the item to which they apply, the figures being written in the Description Column so as not to interrupt the usual order in the Bill, as, for example:—

Bill.

	Feet	Ins.							
	125	...	Run	Moulding 4″ girth. No. 8 mitres. No. 2 mitred and returned ends.					

to the *convex* surfaces of work circular in all directions, such as spheres and domes. If stopped, keep it separate.

Circular Circular Work Sunk *per foot super.* to the *concave* surfaces of work circular in all directions, such as to niche heads, etc. If stopped, keep it separate.

Back Joint.—*Measure per foot run*, and the thickness of stone stated. It is a similar labour to a joint measured to the back of a stone, such as a stone step where it abuts against flooring or paving.

Perforations, Mortices, etc.—*Number* and describe.

Balusters, Finials, and similar items are best *numbered* and sketched, including stone and labour; or the stone may be *measured per foot cube*, and the labour item *numbered*.

Bosting is the labour of roughly bringing the stone to the shape required for the carver, and is *measured per foot super.*, or if a small item is *numbered*.

Carving.—A sum is usually provided for this. Carving of an ordinary kind is often done by the builder, and in this case the items should be numbered and a sketch given, and the "bosting" may be included and the fact stated.

Tracery Heads, when they are not taken off in detail, should be measured per foot cube as stone, and all labour, and very fully described, including joints and slate dowels, mortices, etc., and a sketch of window given. Keep the arch stones with stoolings for tracery worked on separate. State in the description that it includes all strutting and ribbing.

Ashlar.—This may be measured in detail as previously described, but it is more usual to measure it as stone and labour *per foot super.*, stating the average thickness and fully describing it, giving the heights or average height of the courses, the dimensions of the bond stones, and how many to the yard super.

Filling-in to Groined Roofs is usually measured as stone and labour *per foot super.*, and fully described. State that it includes all cutting and fitting to stone ribs, also the requisite centering, and that it is measured nett.

The ordinary items of stonework, such as steps, thresholds, hearths, window-sills and heads, copings, etc., whether in Portland, York, or any other stone, when used in a brick building or not in conjunction with other stonework, are usually measured as stone and labour *per foot run*, and fully described; and only the extra labours upon them are separately measured, such as "sunk joints," "fair ends," "mitres," "mitred and returned ends," etc. These are usually "written short." Some of these have already been dealt with in their order under the heading of "Openings." In the case of gable copings, the kneelers, bonds, stones and apex stones are numbered and described, and their dimensions stated. Give sketches if necessary.

Stone Staircases are rarely measured in detail. The usual method is to *number* the steps and fully describe them, giving their dimensions.

Number the winders, and describe as above. State if soffits are flueing.

Keep steps with curtail ends separate, and fully describe.

Number the mortices for balusters, etc.

Number the ends cut and pinned or built in, and bill in Bricklayer.

Landings, *per foot super.* State thickness, and describe.

Joggle Joint and Back Joint *per foot run.*

Edge Cut and Pinned *per foot run*; billed in Bricklayer. Any labour to edge *per foot run.*

Templates, Base Stones, Corbels, etc., are *numbered*, and described as stone and labour.

Rubble Walling

This, if executed in the district in which the stone is found, is usually measured in accordance with local custom, which varies considerably. In London it is *measured per yard super.* up to and including 18 inches thick, stating the thickness, and *per yard cube* over 18 inches thick. Fully describe the coursing. Facings, if in the same kind of stone, are *measured per foot super.* as extra on the walling, fully describing the coursing, pointing, and how face of stone is finished. Arches are *numbered* and fully described, including cuttings, as extra on facings, and the dimensions (face, soffit, and span) given. Dressings, if in the same kind of stone, are measured as extra on facings, and fully described, stating that they are in "jambs" or "quoins," etc., as the case may be.

Kentish rag or other rubble facing to brick backing is *measured per foot super.* as extra on brickwork, and fully described, and the average thickness stated. State the size of bond stones, and their *number* per yard super.

Constructional Iron and Steel Work

Cast-Iron Columns and Stanchions.—*Measure per foot super.* State thickness of metal and weight out on Abstract. Make an allowance for featherings. This must be judged; as, for instance, a cast-iron column, say 10 feet high, will only have featherings at top and bottom, but a stanchion of the same height would have a very much larger proportion. Of course, it is quite possible to treat them as small triangles and ascertain their actual weight, and the beginner will do well to adopt this practice until he becomes able to judge fairly what percentage to add. *Bill by weight*, and state of what it consists; as, for example, "In No. 10 columns 8 feet high, with moulded caps and bases." Also state the height to which it has to be hoisted.

Number the Patterns, taking one pattern for each variety of casting. Where a pattern can by a slight alteration be re-used, number the "alterations to pattern."

Number the turned ends where iron abuts on iron.

Number the holes drilled or punched, stating their diameter and the thickness of metal.

Number the bolts and describe. State diameter and length, and if lewis, or with heads, nuts, and washers. Take at the same time the mortices in stone for lewis bolts and running with lead.

Cast-Iron Brackets, if small, are better *numbered* and described, especially if ornamental.

Rolled Steel Joists.—These are usually selected from a trade list, and so can be measured *per foot run* and weighted out from the list. Keep those over 30 feet long separate. Include the hoisting, and state the height. State what the weight comprises, as, *e.g.*, "In rolled steel joists not exceeding 8 inches deep, and hoisting and fixing 10 feet above ground," or as the case may be. State that it includes cutting to lengths, or number the cuts, stating size of girder. Take one cut to each length of girder, unless it is a stock length.

Holes and Bolts.—*Number* these as before directed.

Cleated and Bolted Connections.—*Number* and fully describe these, stating the number and size of cleats to each, and the number, diameter, and length of bolts, including drilling and fixing.

Riveted Girders.—*Measure* the plates, etc., *per foot super.*, and *bill by weight.* Add for rivet heads usually 5 per cent. State of what the weight consists, as previously explained. *Number* the holes, connections, etc., as before directed.

Angle Steel Shelf, riveted to web of main girder to receive ends of cross girders. *Measure* the angle steel *per foot run*, and *bill by weight. Number* the rivets, giving diameter and including holes through metal, stating its thickness, and state that they are to angle steel shelf. Number the ends of rolled steel joists connected to the shelf, stating the number and sizes of bolts, holes, etc., in each connection.

Steel Roof Principals.—Measure the various members as previously directed, and *bill by weight* under a separate heading, such as, "The following in No. 10 Steel Roof Principals, including hoisting and fixing 30 feet above ground level." State of what the various weights consist, as previously explained.

Number and describe the forgings, threaded ends, nuts, etc. *Number* and describe the bolts. *Number* and fully describe the plated joints, including the rivets, bolts, holes, etc.

Shoes.—These are now usually built up of steel plates and sections. Measure them up, and *bill them by weight.* Describe the shoes, and state how many.

Plain Railings and Area Gratings, etc.—*Measure* the various sections *per foot run*, *bill them by weight*, and describe them as "framed." *Number* the forged ends, and describe them.

Floors

Fender Walls.—Half-brick fender walls are *measured per foot super.* and *not* reduced.

The Digging, Concrete, and Footings to Fender Walls measured as previously described.

Damp Course.—As before described.

Wall-Plates.—*Measure per foot cube.* As there is usually a lot of this item, and all of the same scantlings, it will often save labour to take these off *per foot run.* State their scantlings and cube the total on the Abstract. Allow in the length twice their width for every angle, and 6 inches for laps every 20 feet in length. Bill as "Fir in plates and lintels."

Sleepers.—Measure and bill with plates.

Ground Joists.—*Measure per foot run* and cube on Abstract as described to plates. Bill as "Fir in ground joists," keeping them separate from upper-floor joists, as there is no framing.

Concrete under Floors.—*Measure per foot super., bill in yards,* and state thickness.

Air Bricks.—*Number* and describe them, and include forming openings (state if cranked), and building-in and rendering openings in cement.

Wall-Plates for Upper Floors.—Taken floor by floor, and measured as before described. Billed as "Fir in plates and lintels."

Plates Fitted and Bolted to Sides of Rolled Steel Joists.—Measure and bill these *per foot run,* and include the holes and bolts in the description, as, *e.g.*, "With and including ½-inch bolts 3 feet apart, with heads, nuts, and washers."

Joists to Upper Floors.—Room by room and floor by floor *per foot run,* cubed on Abstract, and billed as "Fir framed in floors." This will be to all floors having rooms under.

Deduct joists for voids.

Ends of Joists cut and fitted to Rolled Steel Joists.—*Number* these, and state size of joists.

Trimmer Joists.—*Measure* the extra thickness of these *per foot run.*

Trimmers.—*Measure per foot run.*

} Cubed on Abstract, and billed under "Fir framed in floors."

Herring-Bone Strutting.—*Measure per foot run,* stating size, and to what depth of joists.

Roofs

Wall-Plates as previously directed, and all billed together.

Rough Oversailing for Wall-Plates.—The projection is *measured per foot super.*, the length by the height and the projection or average projection stated, and added to the common brickwork, and the labour *measured per foot run* as "Labour to rough oversail, or set back one course." Thus in a two-course oversailing, such as is usually required for a wall-plate, there will be *two* courses oversailed *and* one set back. The following are the dimensions as they would appear for 10 feet run of two oversailing courses of 4½ inches extreme projection, and set back over as Fig. 28:—

		¼ B. ½ B.
		2 | ¾ B.
	10.6 0.6	⅜ B. in M.
		Average ⅜ B.
3/	10.0	Labour to rough oversail, or set back one course.

Roof Timbers.—*Bill per foot cube* as "Fir framed in roofs." It will probably be convenient to measure these *per foot run,* and cube on the Abstract as described to Floor Timbers. Keep trusses separate, and bill as "Fir framed in roof trusses."

Remember that in carpentry all lengths must be measured from the extreme ends of tenons.

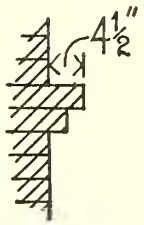


Fig. 28.

Labour to Rough Chamfer.—*Measure per foot run.* Take this as it occurs.

Cleats.—*Number* and describe.

Straps.—*Measure per foot run,* and *bill by weight,* stating what the weight consists of. Number the forgings and holes.

Bolts.—*Number* these, and state their diameter and lengths (which may be averaged), and include "Boring through fir and fixing by Carpenter" in the description.

Ends of Timber cut and pinned.—*Number* these as they occur.

Templates.—*Number* and describe these as they occur, and include building-in in the description.

Corbels.—Number and describe as for Templates.

Ceiling Joists

Wall-Plates.—See previous description.

Joists.—*Measure per foot cube,* and describe as "Fir framed ceiling joists." If of small scantling they may be taken per foot run.

Trap Doors.—These may now be *numbered,* including the trimming for them, and the linings and ironmongery complete.

Deduct Lath and Plaster Ceiling.

Labour to Quirk—*Measure per foot run.*

Slating, Boarding, and Felt are measured together, but abstracted and billed separately. Measure the length of the roof by the length on slope, and notice that, whether the roof be hipped or has gables, the area of slating will be the same. Bill the slating and boarding in squares, and the felt in yards super., the latter measured nett and so described. Describe the laps and kind of nails, whether copper, etc., and their weight per thousand.

Slating.—State the size of slates, width of lap, and kind of nails and weight per thousand.

Keep Vertical Slating separate.

Boarding.—State thickness, and if edges shot.

Battens.—Measure per square as to Boarding. Describe the size of slates and the gauge. Make the same allowances for cuttings as to Boarding (see below).

Allowance for Double Eaves Course.—Add the length of the eaves by half the length of the slates.

Tilting Fillets.—*Measure per foot run*, and state size.

Cuttings.—Deduct all openings in slating for chimneys, skylights, etc., and add the length of their edges by 6 inches.

Add the length by 6 inches for all irregular edges, and to both sides of hips and valleys.

Where the bottom edge of vertical slating is raking, as to a dormer cheek, allowance must be made for both cutting and double eaves course.

Bedding Slates and Cement Hollow Fillet to Verge.—*Measure per foot run.* If slate and a half be used in alternate courses, state it.

Cuttings to Boarding.—The same as to slating, but 3 inches wide instead of 6 inches.

Ridges and Hips of tile or slate.—*Measure per foot run*, and describe, including the method of fixing. Number and describe the intersections.

Lead-Covered Ridges and Hips.—Measure the roll per foot run, and describe size, and how fixed, etc. *Measure* the lead *per foot super.*, and *bill by weight.* Add to the length 4 inches for each 7 feet length, to allow for tacks and passings.

Number the mitres and intersections, and describe, as, for instance, "Bossed intersection of ridge with two hips," or as the case may be.

Valley Boards.—*Measure per foot run.* State size, and describe them as splayed and fitted.

Valley Fillets.—*Measure per foot run*, stating size.

Lead to Valleys.—*Measure per foot super.*, and *bill by weight.* Measure the length by the width, add to the length 4 inches for each 7 feet of length to allow for clips and passings. A reasonable width to take if not specified would be 20 inches.

Gutter Boards and Bearers.—*Measure per foot super.*, the length of the gutter by the width. State thickness of boards and size of bearers, and if framed.

Narrow Gutter Boards and Bearers under 6 inches wide.—*Measure per foot run.*

Rough Deal Fillet Plugged (against walls and parapets to receive ends of bearers).—*Measure per foot run*, and state size.

Gusset Pieces to ends of back gutters to chimney stacks, etc.—*Number.*

Short Lengths of Deal Roll, up to 30 inches long.—*Numbered*, and length stated. (This may be averaged.)

Short Lengths of Rebated Drip and Narrow Riser up to 30 inches long. *Number*, and state depth and length. (Lengths may be averaged.)

Lead to Gutters.—*Measure per foot super.*, and *bill by weight.* Add to the length of the gutter 6 inches for each $1\frac{1}{2}$-inch and 8 inches for each 2-inch drip or roll. Add sufficient at ends for the turn up or dressing over, as the case may be. Take the average width, including portions turned up against walls (usually 6 inches) and under slates (usually 9 inches).

Cesspools.—*Number* and describe, and state the internal dimensions, as, *e.g.*, "$1\frac{1}{4}$-inch deal dovetailed cesspool, with dished hole for outlet; size, 9 inches by 9 inches, by 6 inches deep in clear."

Lead, etc., to Cesspools.—Measure the extra lead required, and add it to the gutters.

Extra Labour and Solder to Cesspools.—*Number.*

Copper or Galvanised Wire Covers to Outlets.—*Number* and describe, state gauge of wire.

Lead Socket Pipes.—*Number* and describe thickness of lead, diameter and length of pipe, and how many times bent. Include the tafted and soldered joint to cesspool in the description.

Holes through Brick Wall for Lead Socket Pipes.—*Number.* State diameter of pipe and thickness of wall, and include making good brickwork and facings in the description.

Soakers.—*Measure per foot super.*, stating weight of the lead. *Bill by weight*, and describe as "In soakers." The size of a soaker is equal to the gauge plus the lap of slating or tiling + 1 inch, by usually 8 inches wide. Take one to each course of slating.

Soakers, fixing only.—*Number* the soakers, and bill in Slater or Tiler for fixing only.

Flashings.—*Measure per foot super.*, and *bill by weight.* Add to the length 4 inches for every 7-foot length, and 6 inches for every angle. Flashings are usually 6 inches wide.

Rake out, Wedge, and Point Flashings.—*Measure per foot run.* Measure as for flashings without any allowances. State whether lead or oak wedges are used.

Stepped Flashings.—Measure in the same way as flashings, and with the same allowances, but keep separate.

Rake out, Wedge, and Point Stepped Flashings.—Measure this in the same way as to Flashings, but keep it separate, and describe it as to Stepped Flashings.

Fascia.—*Measure per foot run*, and describe, stating thickness and width and how fixed.

Mitres to Fascia. — *Number*, keeping internal and external separate.

Fitted Ends.—*Number.*

Eaves Gutters (cast iron).—*Measure per foot run.* State size, section, and weight per yard, or give catalogue number and how fixed, and if including the clips.

Angles.—*Number*, keeping internal and external separate.

Stopped Ends.—*Number.*

Spigot Outlets.—*Number.*

Wire Covers.—*Number* as before directed.

Rain-Water Pipes.—*Measure per foot run.* State diameter, or size if square, and weight per 6-foot length. Describe the ears, nails, jointing, and mode of fixing. If it is measured nett, state that it includes all short lengths.

Swannecks, Plinth Bends, Shoes, Heads, Junctions.—*Number* these. If their length has already been measured in with the pipe, describe them as "Extra for." State the projection of the bends. Give a p.c. value for the heads, or state their catalogue number. If any of these are purpose made, state it.

Labour to Beamfilling. — *Measure* per foot run. State thickness of wall and average height.

Chimney Stacks

Deduct Rafters.

Add for Trimmer Rafters,—their length by their extra thickness by their depth. These may be taken off, run, and cubed on the Abstract as previously described.

Add for Trimmers *per foot cube.* Remember to measure in the tenons in the length.

Deduct Slating or Tiling . . .
Deduct Boarding . . . .
Deduct Felt . . . . .
Add Cuttings to Slating or Tiling
Add Cuttings to Boarding . } As previously directed.

Follow on with gutter boards and bearers, short lengths of roll, gusset pieces and titling fillets. Lead in gutters, soakers, flashings, stepped flashings, and aprons. Fixing soakers, and rake, wedge, and point flashings, and step flashings, the modes of measurement for which have been already explained.

Skylights.—Measure the same items as to chimney stacks, except that there will be no stepped flashing, and that copper nailing and bedding edge of lead in white lead will take the place of rake, wedge, and point. State whether the copper nailing is "open" or "close." "Close" is about 1 inch apart.

Ridge and Hip Rolls, if any, and the lead to ditto are measured as previously explained.

Curb.—*Measure per foot run*, stating size, and describe as "Wrot dovetailed curb," or as the case may be.

Skylight.—*Measure per foot super.*, and fully describe, stating the thickness, and if with moulded or chamfered bar. If hipped, state it, also if hung or fixed. If a portion only is to open, *number* it as "Extra," and state size and fully describe.

Ironmongery. — *Number.* In the case of pulleys, lines, and cleats, the height above floor should be stated.

Glazing.—*Measure per foot super.* State the widths. Any irregular portions to be measured, *square* and described as "Cut to shapes measured square."

Copper Tail Clips.—*Number*, and state size and gauge.

Condensation Sinkings. — *Number* and describe. Give sketch if necessary.

Condensation Holes.—*Number*, and state thickness of wood.

Linings.—*Measure per foot super.*

Shaft.—If there be a shaft formed from skylight to ceiling level, this should now be measured. If lath-and-plastered, the fir backings might be measured as "fir framed in roofs," and the lath and plaster billed with that to partitions.

Deduct Plaster Ceiling.

Add Plaster Quirk.

Lantern Lights.—The deductions and additions of roof timbers, slating, boarding, and felt, and items of gutters, flashings, etc., will be as previously described to Skylights, and the roof of Lantern Light measured as described for Skylights, also the curb, linings, etc. The vertical lights and framing will be measured as follows :—

Cill (generally of oak or teak).—*Measure per foot run.* State size and describe.

Framed and Mitred Angles to Cill.—*Number.*

Galvanised Iron Tongue (if used), and grooves in oak and fir.—*Measure per foot run* in one dimension, but bill in three items ; or the groove in the oak cill may be included in the description of the cill.

Angle Posts.—*Measure per foot run.* Describe as "framed," stating size and labours upon them. Measure the framings in.*

Intermediate Posts, as last described.

Head, as last described. Notice that this will probably be splayed on top.

Casements or Sashes.—*Measure per foot super.*, and describe. State if in small squares, and if fixed or hung. State in the description the *number* of sashes in the total superficial quantity.

Glazing.—*Measure per foot super.* Keep separate, squares under 2 feet, 4 feet, 6 feet, etc., super. per square.

If the sashes are grooved for condensation, measure the groove *per foot run.* If in short lengths, state it, and number the holes.

Sets of Cut Beads.—If sashes are hung on centres, *number* the sets of cut beads, and state the average length per set.

Ironmongery.—*Number.*

Dormers.—*Measure* the deductions and additions of roof timbers, slating or tiling, boarding and felt, as

* By this it is meant that the posts are measured their extreme length from end to end of tenons.

previously explained. If the dormer has a pitch roof, remember to measure the cuttings to main roof to front and vertical sides only. The remainder will be covered by the cuttings to valleys.

The roof of dormer and the valleys, etc., will be measured as described under Roofs. If a flat, then measure as described under Flats.

Where the ridge of a dormer or any ridge abuts against the sloping surface of another roof, remember to take a lead soaker about 18 inches square. Bill it by weight, and number the fixing in Slater or Tiler.

Timbers in Cheeks.—*Measure per foot cube*, and bill with "Fir framed in roofs."

Boarding.—Measure as to roof boarding, but describe as vertical. Make the same allowances for cuttings. If for lead covering, state that the edges are shot.

Covering to Cheeks.—If of slate, measure as to slating, but keep separate and call it vertical. At the bottom edge make allowances for both cutting and double eaves course.

If of lead, *measure per foot super.*, and *bill by weight.* Measure the copper nailing *per foot run; number* and describe the lead tacks, soldered to back of lead, and screwed with brass screws to inside of boarding. Include the perforation in boarding, or number it separately in Carpenter; *or*, if soldered dots are used, *number* "brass screws and soldered dots and sinkings in deal" in one item.

Soakers.—Previously described.

Or, if a Secret Gutter, measure and bill the lead with gutters. Allow 3 inches every 7 feet for passings; take a tilting fillet, and measure the labour dressing lead over fillet per foot run. If the roof is not boarded, take flashing boards per foot super.

Lead Apron to front, usually 12 inches wide; billed with Flashings.

Copper Nailing to Lead Aprons.

Trap Doors

Deductions and additions to main roof as to Skylight, etc.

Curb.—See Curb to Skylight.

Lead Covering to Curb *is billed by weight*, and kept separate. Allow 3 inches for passings and 6 inches at angles.

Copper Nailing to Ditto as previously described. The lead covering of curb may be dressed over slates at sides and front, in which case take tilting fillets to sides; or it may be dressed under the slates and over fillet as a secret gutter; or it may form a cover flashing over soakers. The modes of measurement in either case have been previously explained.

Take a back gutter as to Skylights.

Trap and Rims.—This is better *numbered* and described in one item.

Lead Covering to Trap.—*Measure per foot super.*, and *bill by weight*, and describe as in Covering to Trap.

Bossed Angles to Ditto.—*Number.*

Copper Nailing.—*Measure per foot run.*

Lead Flats

Rough Oversailing, as previously directed.

Wall-Plates, as before directed.

Joists.—Measure and bill as "Fir framed in roofs."

Boarding and Firrings to Falls.—Measure per foot super., and billed in squares. If firrings are more than 3 inches deep, call them "Deep firrings." Describe the boarding as, "With edges shot for lead."

Rebated Drips and Narrow Risers.—*Measure per foot run.* State if 1½ or 2 inches. If across grain, call them "Cross rebated."

Rolls.—*Measure per foot run.* State diameter.

Lead to Flats.—*Measure per foot super.*, and *bill by weight.* Add to nett length 6 inches for turn up against wall, and 6 inches at eaves (unless otherwise shown or specified), 6 inches for every 1½-inch drip, and 8 inches for every 2-inch drip. Add to the width 6 inches for turn ups, and 6 inches for every 1½-inch roll, and 8 inches for every 2-inch roll.

Bossed Ends to Rolls.—*Number.*

Bossed Saddles to Rolls.—*Number.* If on splay, state it and keep separate.

Bossed Intersections.—*Number.* State if three-way or four-way.

Gutter Boards and Bearers and Lead to Ditto, Cesspools, etc.—All as previously described; also Flashings, and Rake out, Wedge, and Point Ditto.

Cross Rebated Drip and Splayed Riser as Gutter Side *per foot run.*

Measure per foot run Labour dressing lead over moulding or into eaves gutter, or as the case may be.

Number the labour dressing lead into rain-water heads, etc.

Partitions

Measure the timbers *per foot cube*, the tenons to be measured in. It will often be convenient to *measure per foot run*, and cube on the Abstract as explained for floors. Bill as "Fir framed in quarter partitions." Keep trussed partitions separate, and bill as "Fir framed in trussed partitions," and note that the whole of the timbers, including the quarters, will be so billed. Measure the nogging pieces *per foot run*, and state their size. *Number* the solid bridging pieces, and state that they are framed in between joists, and give depth of joists. These are taken where the sill of partition runs parallel to the floor joists. They should be about 2 feet 6 inches apart.

Bricknogged Partitions.—Measure the timbers, and bill with quarter partitions. Measure the brickwork *per foot super.* over the whole surface (not to be reduced), and describe as "in bricknogged partitions, timbers measured in."

Ironwork in Straps and Bolts.—See similar item under Roofs.

CHAPTER IV

QUANTITIES: "TAKING-OFF" FINISHINGS

(Contributed by W. H. Brown, F.S.I.)

Plastering and Paper

Ceilings.—*Measure per foot super.*, and *bill in yards*, and describe as "Lath plaster, float, and set ceilings," or as the case may be. The same dimension answers for whitening or distempering. If ceiling be panelled, state it, and give the size or average size of the panels. If between wood ribs, state it, and that it includes fitting to ribs; or a better way is to measure the labour fitting against wood or stone per foot run. This is measured wherever the plaster stops against wood or stone. Keep sloping ceilings separate. Keep curved ceilings separate, and state the radius.

Lath and Plaster in Narrow Widths, as to soffit or sides, and soffits of girders, etc., to be kept separate and described.

Counterlathing *per foot super.* If in narrow widths, keep separate.

Voids.—Deduct these as they occur, as for stairs, etc.

Moulded Ceiling Ribs.—*Measure per foot run*, stating girth, and that they include the requisite screeds, and cutting to form key.

Include "setting out" in the description, or take a numbered item for "setting out to geometrical pattern," giving the dimensions of the ceiling.

Half-Mitre.—*Number.* Keep irregular ditto. separate.

Bracketing *per foot super.* the length by the girth, and state thickness. *Number* the angle brackets as "Extra for," and measure fillet for fixing brackets to, per foot run; *or*,

Measure the bracketing *per foot run*, giving the girth of cornice. State the thickness, and include the fillet. *Number* the angle brackets, and write them short in the Bill.

Cornices, Frieze Rails, etc.—*Measure per foot run* up to and including 12 inches girth, and per foot super. over this. State if they include "dubbing out." If they are on bracketing, state that they are "on and including lathing."

Internal Mitres, External Mitres, Mitred and Returned Ends, etc.—*Number*, and write short under the mouldings billed run. Where the mouldings are billed super., bill the mitres, etc. under "Numbers," and state girth of mouldings.

Enrichments.—*Measure per foot run*, and describe.

Mitres, etc., as to mouldings.

Coves.—A small cove, if part of a cornice, would be measured as such; otherwise *measure per foot super.*, the length by the girth.

Mitres, etc., as to cornices.

No notice is taken of short lengths of cornice where they occur in the ordinary way in a room, as to chimney breasts, etc., but where there are an unusual number they should be kept separate.

The dimensions for cornices, coves, etc. will also answer for whitening or distempering. State what it is to, or it may be included in the description of cornices, etc.

Walls.—*Measure per foot super.*, *bill in yards* and describe as "render and set," or "render, float and set," etc., as the case may be. The same dimension serves for distemper, paper, etc. Keep narrow widths as to reveals, etc., separate, and bill in feet. Reveals not exceeding 9 inches wide are measured per foot run.

Arrises.—*Measure per foot run.* If with a reveal not exceeding 9 inches, measure and describe the two together as "arris and 6 inches return," or as the case may be.

Keene's Cement Angles.—*Measure per foot run*, and state widths of wings or returns, as "Keene's cement angle and two 1-inch returns on Portland cement grounds." A portion of this description is, however, usually saved, as this item would be under a heading of "Keene's cement," which might have the following note attached: "All Keene's cement to be on Portland cement grounds."

Staffbead and Double Quirk to Angles.—*Measure per foot run*, stating girth.

Number the mitres, and *number* and describe the stops, whether plain, moulded, etc.

Partitions.—Lath plaster and set; lath plaster, float, and set, etc.—*Measure per foot super.*, and *bill in yards.* The remarks under Walls will apply here, with the altered description; and the arrises, angles, etc., will be measured as just described. Take counterlathing as it occurs. If in narrow widths, keep separate and bill in feet super.

Floors and Skirtings

Flooring—*Measure nett per foot super.*, and *bill in squares* of 100 feet super., and describe.

Cuttings are measured to all raking edges. Some surveyors allow the length by 3 inches for these, but it is far the better practice to measure and bill all such labours per foot run.

Deductions.—Deduct all voids as they occur, including hearths.

Glued and Mitred Margins to Hearths.—*Measure* these *per foot run* as extra on flooring, stating the thickness of flooring and width of margin.

Flooring in Openings and Recesses.—Measure and bill separately, and describe as in small quantities in openings and recesses, including bearers. Bill in feet super.

Sinkings for Mats.—*Number* these, and state size (which may be averaged) as "Labour forming sinkings in 1-inch flooring," or as the case may be, "including cutting-down joists"; or if a cement finish is specified under the mat, deduct the flooring and take a numbered item for "cutting-down and filleting joists, $\frac{3}{4}$ inch pugging boards, coke-breeze concrete filled in between, and $\frac{3}{4}$-inch cement floated surface." The mitred margin and riser may in either case be included with the numbered item, or *measured per foot run* as extra on flooring for glued and mitred margin and wrot fillet rebated both edges, and grooves in flooring and margin. If cement finished sinking, omit the "groove in flooring" from the description. State the thickness of flooring, width of margin, and size of riser.

Scribing.—*Measure per foot run*, where edge of flooring adjoins pavings, etc.

Wood-Block Floors.—*Measure per foot super.*, and *bill in yards*. Fully describe the flooring and method of laying, and state that it includes all cutting and fitting to walls, and is measured nett. If one of the patent kinds be specified, get an estimate from the manufacturers and treat as a provision; or measure as above described, and state that it is to be laid complete by the manufacturers.

Skirtings.—*Measure per foot run*, and describe them, including the grounds. If tongued to floor, state it, and include the groove. If against walls, state that they are plugged.

Deduct for Doors, etc.; or this may be done at the time of measuring the door, in which case the fitted ends or housed ends against the architrave would be taken at the same time.

Tongued and Mitred Angles External and Internal, Fitted Ends, Housed Ends, etc., are numbered and written short in Bill. Take heading joints to lengths over 20 feet.

Rough Rendering behind Skirtings.—*Measure per foot super., billed in yards.* If on partitions, state that it includes lathing.

Deduct Render, Float and Set, or Lath, Plaster, Float and Set, if this has previously been measured down to floor.

Dados (Wood).—*Measure per foot super.*, and describe. If panelled, state how many panels in height. Include grounds with the description. State their size, and if plugged.

External and Internal Angles, Housings, etc.—*Measure per foot run*, describing them and including any bead or moulding as, *e.g.*, "Rebated, grooved, and moulded external angle."

Capping.—*Measure per foot run*, and describe.

External and Internal Mitres, Fitted Ends, etc.—*Numbered.*

Rough Rendering, and deductions of rendering or lath and plaster.—See similar items under Skirtings.

Fireplaces

Deduct Plaster and Paper.

Take a numbered item for making good plaster around chimney-pieces.

Windows

Double-Hung Sashes.—Refer to the dimensions of Window Openings.

Sashes and Frames.—*Measure these per foot super.* The dimensions will be the same as the brick deductions for internal reveals. Fully describe the sashes and frames, and keep the different kinds separate. Where two or more different descriptions occur in a building, much writing may be saved on the dimension sheets by referring to them by letter. The following example gives two ordinary descriptions of double-hung sashes and frames:—

Feet	Ins.			£	s.	d.
80	...	Sup.	Deal cased frames of 1″ inside and outside linings, 1¼″ pulley stiles, and ¾″ back lining, with inside beads, parting slips, etc.; all rebated and grooved together, and 3″ oak sunk, weathered, and cheek-throated sills, and 2″ ovolo-moulded sashes, double hung, with best flax lines, brass axle pulleys, and iron weights; the frames grooved all round for finishings; in No. 4 windows.			
50	...	...	Do. do. but divided into small squares by 1″ ovolo-moulded sash bars; in No. 3 windows, in No. 12 squares each.			

Venetian Frames and Sashes, Two-Light Frames, with centre boxing and sashes, etc.—*Measure* as just described, and give their full description.

Glass.—*Measure per foot super.*, and keep the different

size squares separate, as in squares not exceeding 2, 4, 6, or 8 feet sup. per square, or as the case may be. Glass in irregular shapes should be measured square, and described as cut to shapes. In the case of plate glass in large squares, instead of describing it as cut to shapes, it is better to measure circular cutting and risk separately *per foot run*. Quadrant corners may be numbered and radius stated.

Horns.—*Number* the moulded horns.

Labours.—Any extra labours to meeting or bottom rails should be measured *per foot run*.

Water Bar and Bedding in White Lead.—*Measure per foot run*.

Groove in Stone (stating what kind of stone).—*Measure per foot run*, if not already included in the descriptions of the stone and oak sills respectively. In the case of double-hung sashes and frames, the groove in oak should always be separately measured, otherwise its value has to be spread over a super. dimension. Use the same dimension as for the water bar.

Groove in Oak.—*Measure per foot run*, etc., as above.

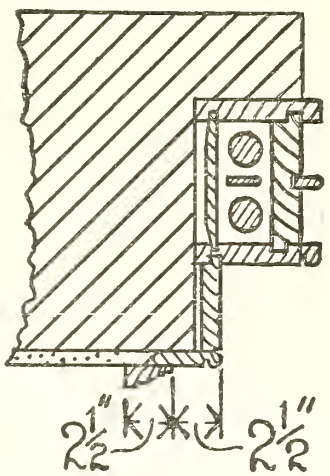


Fig. 29.

Furniture.—Number the sash fasteners, sash lifts, and sash pulls, and state their p.c. value.

Deduct Plaster and Paper or Distemper, etc.

Linings up to 9 inches in width are better *measured per foot run*. Over that *measure per foot super.*, and state that they are cross-tongued, and fully describe the labours on them. Include backings in the description. State if backings are framed. Keep splayed linings separate, and so describe them. Fully describe panelled linings, and state the number of panels in the set.

Architraves.—*Measure per foot run*. Take the extreme length on the outside edge, and include the mitres and grounds. If the architraves are on wrot framed grounds, *measure* the grounds separately *per foot run*, the extreme length on the outside edge.

Note.—In measuring linings, grounds, architraves, etc., the only dimensions actually measured will be the nett brick opening, for which refer to previous sheets; and in practice it is usual to supply the same dimension for the length of the linings, making no allowance for backings. The length of wrot grounds will then be the same dimension plus four times the distance between back of lining and outside edge of grounds for passings at angles. The dimension for the architrave will be that for the grounds plus four times the projection of the outer edge of architrave beyond the outer edge of grounds. Take, for example, a window opening, the dimension for deduction of internal reveal being 3 feet 9 inches by 7 feet 3 inches, finished with 1-inch rebated linings, and $\frac{3}{4} \times 4$-inch wrot framed and beaded grounds, and $1 \times 2\frac{1}{2}$-inch moulded architrave, as Fig. 29.

		2/ 7.3 = 14.6 3.9 18.3
18.3		1″ × 3½″ wrought rebated linings and backings.
		18.3 4/ 3″ = 1.0 19.3
18.9		¾″ × 4″ wrought, framed, splayed, and beaded grounds.
		19.3 4/ 1″ = 4 19.7
19.7		1″ × 2½″ moulded architrave and mitre.

Window Nosing.—*Measure per foot run*, and describe as "tongued and rounded," or as the case may be. If with small moulding tongued on under, this may be included.

Number the notched and returned ends, mitres, fitted ends, etc.

Window Board and Bearers up to 9 inches wide.—These are best *measured per foot run* as described for Window Nosings. Over 9 inches wide, *measure per foot super.*, and describe as cross-tongued; and any moulding under should be separately measured, and describe as rebated and grooved to under side of window board. *Number* the notched and returned ends, mitres, fitted ends, etc., of window boards, and separately *number* returned ends, fitted ends, and mitres to moulding under; in the latter case these numbered items are "written short" in the Bill.

Note that any item described as "rebated and grooved," or "tongued and grooved," includes both the rebate, or tongue, and the groove; but if only described as "rebated," or "tongued," the groove must

be separately measured, unless it has been included in the description of the item in which it occurs; as, for example, when window frames are described as "grooved" all round for furnishings. When groove is measured separately, if it cannot be run right through, describe it as "stopped."

Arch Boards over square frames in segmental headed openings are *measured per foot run*, and thickness and extreme dimensions given. State that they are tightly scribed to soffit of arch. Sometimes an extra deep head is specified to the frame for the same purpose, to run up behind the arch when the frames are within reveals. Measure this per foot run as extra on sashes and frames for head being so many inches deep.

Casements are *measured per foot super.*, and described. State how many in the superficial quantity. If in small squares, state it, and if hung or fixed.

Glass, as before described.

Hinges, Fasteners, and Stay Bars, etc.—*Number.*

Frame.—*Measure per foot run*, and describe. Allow in the length for framings and horns (if any).

Mullions.—As last. Describe as "framed."

Transome.—As last. Describe as "framed."

Sill.—As last. Describe as "framed."

Water Bar and bedding in white lead . . . . . } See p. 70, *ante*.
Groove in stone . . . . . }
Groove in oak . . . . . }

Any special labour to frame or casement which cannot conveniently be included in the description is *measured per foot run*; as, for example, any special labour to meeting stiles or bottom rails of casements.

Deduct Plaster.

Linings, Architraves, Window Nosings, or Window Boards and Arch Boards. See p. 70, *ante*.

External Doors

Fanlight.—*Measure per foot super.*

Glass.—As before described.

Ironmongery.—As before described.

Door.—*Measure per foot super.*, and fully describe. State thickness, and in how many panels, etc. If any unusual arrangement of panels, give sketch.

Keep folding doors separate. Allow in the width for rebates to meeting stiles. Describe them as "folding," and state in how many panels the set. Measure the labour to rebate and bead per foot run. Where doors are to be glazed, state that the "top panel" is open, and prepared for glass with loose mouldings, fixed with brass cups and screws, mitred around, or as the case may be. If sashed in small squares, state it.

Glass.—As previously described.

Hinges and Furniture.—As previously described.

Door Frame and Transomes.—As described for Casement frames.

Iron Dowels and Mortices in fir and York stone are *numbered*, and billed in three items in Ironmonger, Joiner, and Mason. Where one dimension has to be billed three times it is entered on the dimension sheets as follows:—

22/	2.		G.I. dowels
			and
			Mortices in York stone
			and
			Mortices in fir.

Linings, Architraves, Foot Blocks, Arch Board, etc.—*Measure* as described to Windows.

Groove for linings or plaster.—*Measure per foot run.*

Deduct Plaster and Paper.

Internal Doors

Door, Glass, Hinges, and Furniture.—*Measure* as previously described.

Linings.—*Measure per foot run* or *per foot super.* Describe as "1½-inch wrought double rebated jamb linings, tongued at angles and backings," or as the case may be. If backings are dovetailed, state it. If the linings are framed and panelled, describe it, and state in how many panels the set. The dimension for the length will be twice the height plus the width of the door plus four times the thickness of the linings, for passings at angles.

Architraves.—As before described.

Stairs

Treads and Risers.—*Measure per foot super.* State their respective thicknesses, how put together, and, if prepared for close or cut strings, include the rough fir carriages and state their scantlings. The dimensions will be the girth by the width. The girth may be readily ascertained as follows. To the nett length occupied by the fliers on plain add 1 inch for every rounded nosing, and 1½ inch for every moulded nosing. If details are supplied, the correct allowance for nosings can be ascertained by actual measurement.

Winders and Risers.—*Measure per foot super.* These must be measured in two operations. First measure the nett length by the width on plan, then take the collected length of the risers, by the rise, plus the allowance for nosing. Describe them as cross-tongued.

The following example shows how the stairs illustrated in Fig. 30 should be "taken off":—

		5·3 12 9 | 63 ins. 7″ rise.
		4.6 7/ 7″ = 4.1 Nosings 6/ 1″ = 6 9.1
9.1 3.0	27.3	1¼″ T. and 1″ R., including rounded nosings, rebated and grooved together, glued, blocked, and bracketed on, and including No. 2, 3″ + 4½″ fir carriages.
3.0 3.0	9.0	1¼″ cross-tongued winders, and 1″ risers, and do. do., all as last described.
		3.0 rise 7″ 3.6 3.6 nosing 1″ 10.0 8″
10.0 8	6.8	
	15.8	

Bull-Nose or Curtail End to bottom step.—*Number*, and describe as "Curtail (or Bull-Nose, as the case may be) end to bottom step, and blocked and veneered riser."

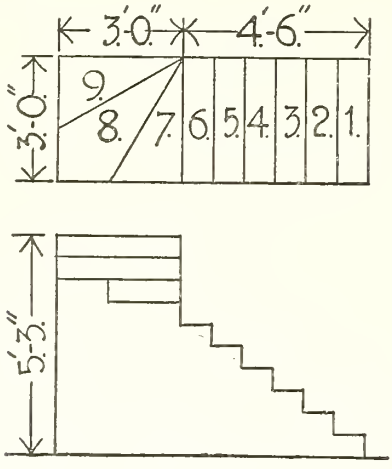


Fig. 30.

Landing.—*Measure per foot super.* State thickness, and describe as cross-tongued, and include bearers, stating their size.

Wall String.—*Measure per foot run.* State thickness, and describe. Include backings, and state if plugged. Keep ramped string separate.

Mitres.—*Number.*

Heading Joints.—*Number.*

Short Ramps (*i.e.* where the raking string meets the straight on a landing). *Number* as "Extra for," and include the heading joints.

Close Outer String.—*Measure per foot run.* State thickness, and describe.

Framed Ends.—*Number.*

Framed Ends on Splay.—*Number.*

Ends of Steps (state whether with rounded or moulded nosings) housed to Strings (Step includes tread and riser).—*Number.*

Ends of Winders and Risers housed to Strings.—*Number.*

Ends of Risers only housed to Strings.—*Number.*

Cut and Mitred Outer String.—*Measure per foot run.* State thickness, and describe.

Cut and Mitred Outer String Wreathed.—*Measure per foot run*, and state thickness; or if to a small radius, *number* it, state the length and radius, and include the heading joints.

Heading Joints.—*Number.*

Ends framed on Splay.—*Number.*

Short Lengths of Rounded (or Moulded) Nosing, tongued and mitred to treads and returned at one end.—*Number.*

Cut Brackets.—*Number* and sketch, state thickness.

Newels.—*Measure per foot run.* Call them framed, and describe them.

Turnings to Newels.—*Number*, and state average length.

Ends turned as Finials, or shaped and turned, as the case may be.—*Number* and sketch, stating length.

Ends turned as Pendants.—As to finials.

Ends of Treads (state whether with rounded or moulded nosings), notched and fitted to Newels.—*Number.*

Ends of Risers housed to Newels.—*Number.*

Ends of Winders (state whether with rounded or moulded nosings), notched and fitted to Newels.—*Number.*

Risers to Winders, housed to Newels.—*Number.*

Handrail.—*Measure per foot run*, and describe. including dowelled heading joints and handrail screw; *or* the heading joints may be separately *numbered.*

Handrail, Wreathed.—*Measure per foot run.*

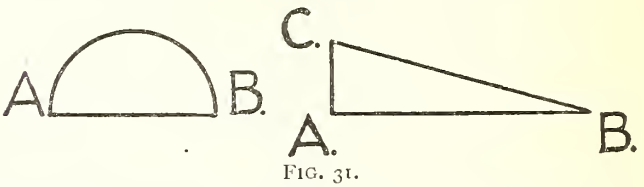


Fig. 31.

Short Ramps and Wreaths may be *numbered*, and length and radius given, and the heading joints with the straight included.

Framed Ends.—*Number.*

Framed Ends on Splay.—*Number.*

Ends cut and pinned to wall and plaster made good. *Number.*

Note.—To measure a wreath (see Fig. 31), take the length A to B round the curve on plan, and set it out on a straight line AB. Set up the rise AC perpendicular to AB. CB will be length of wreath.

Balusters.—*Number* and give size, description, and length, or average length, and describe the framings, as, *e.g.*, "one end housed to deal string and one end to mahogany handrail." Keep those housed on splay separate, and so describe them.

Tongued and Rounded (or Moulded) Nosings to edge of landings.—*Measure per foot run* as extra on flooring. *Number* the quadrant corners (state radius) and fitted ends. Keep circular portions separate. If small, these may be *numbered*, and their length and radius stated.

Groove in Floor for Nosings.—*Measure per foot run.*

Groove in Floor across Grain.—*Measure per foot run.*

Apron Linings.—*Measure per foot run*, and describe, with the labours upon them. Keep circular portions separate. If small, *number* them, stating length and radius. *Number* the mitres, housings, etc.; also quadrant corners, stating radius.

Plaster Quirk.—*Measure per foot run*; also groove in apron lining if not included in their description.

Lath Plaster, Float, and Set Soffit of Stairs.—*Measure per foot super. Bill in yards.* Keep flueing soffits separate.

Plaster Quirk.—*Measure per foot run*; also groove for plaster, if not included in the description of outer string.

Spandril Framing.—*Measure nett per foot super.*, and so describe it. If the door is uniform with the framing, number it, and describe as extra for forming door in same, and state number of panels. Write it short in the Bill.

Rebate and Bead.—*Measure per foot run.*

Stop.—*Measure per foot run.* State size, and include the mitres.

Hinges, Locks, and Furniture.—*Number.*

Fittings

Shelving.—*Measure per foot super.* Describe as cross-tongued if over 9 inches wide. Include bearers in the description, and state their size, if chamfered and if plugged. This only means the bearers against walls or partitions. If edges of shelves are rounded or moulded, take a running dimension of the labour.

Ship Lap Joints.—*Measure per foot run*, where end of one shelf abuts against front of another.

Framed Bearers.—*Measure per foot run.*—Allow for framings, and state size and if wrought. *Number* ends cut and pinned, and plaster made good to.

Gallows Brackets.—*Number.* State height, projection, and scantlings, and if plugged.

Cupboard Front.—*Measure per foot super.*, and describe, including the doors, as, *e.g.*, "$1\frac{1}{4}$-inch wrought and beaded cupboard front, with four-panel moulded and square doors in same," or "with moulded and square doors in same, hung folding in No. 8 panels the set," or as the case may be. If dwarf cupboard front, state it. Take plugging per foot run to edges of framing against walls.

Labour to Rebate and Bead.—*Measure per foot run.*

Hinges and Ironmongery.—As before.

Cross-Tongued Cupboard Ends.—*Measure per foot super.*, and state thickness.

Angles.—Measure the angles *per foot run*, and describe as "tongued and mitred," "rebated, grooved, and beaded," or as the case may be.

Solid Quadrant Corners.—*Measure per foot run.* State radius, and describe them as "grooved and tongued," or "grooved and rebated to framing both edges." The framing should be measured short of these.

Cross-Tongued Top.—*Measure per foot super.* Include bearers.

Scribing to Top.—This should only be measured to raking edge, or edge against brickwork.

Note.—In addition to scribing, remember to make the usual allowance of 3 inches for cutting and waste to all raking edges of shelves, cupboard tops, etc., or to take a *lineal dimension* of this labour, stating the thickness of the material.

Shelves.—*Measure* as previously described.

Cornice.—*Measure per foot run*, and describe, stating size.

Mitres.—*Number.*

Mitred and Returned Ends.—*Number.*

Fitted Ends.—*Number.*

Dresser.—*Number* and fully describe, giving length and height, and thickness and width of top; state the number of drawers, and in how many rows, and describe them, including locks, knobs, etc. Also describe cupboards, including ironmongery, shaped ends, and standards (state how many), how many tiers of shelves, and their thickness and respective widths, top cornice, back, etc., complete. *Number* the dresser hooks.

Wood Sinks

Sides.—*Measure per foot super.* State thickness, and describe as dovetailed. State if cross-tongued, if wrought both sides, and if prepared for lead.

Bottom.—*Measure per foot super.* State thickness. Describe as cross-tongued and screwed. If with brass screws, state it, and if prepared for lead.

Dished Holes for Outlets.—*Number.*

Bearers to Sinks.—As described under Shelves.

Lead Lining.—*Measure per foot super.*, and *bill by weight.* "Lead in sinks and cisterns" is billed together. Take the two ends and bottom in one piece, and a piece for each side. Allow 1 inch for lap

at soldered angles, and the thickness of the sides for turn over at top.

Soldered Angles.—*Measure per foot run.* Take four vertical angles, and two where sides meet the bottom.

Copper Nailing.—*Measure per foot run* around top edge.

Brass Washer and Waste.—*Number.* State size, and include the joints to sink and lead trap. If with grating or plug and chain, include these.

Trap.—*Number* and describe, and state size, as, *e.g.*, "2-inch Dubois drawn-lead trap with brass cap and screw burnt in, and joint to lead pipe."

Waste Pipe.—*Measure per foot run*, stating size and weight per yard. Include wall-hooks or lead tacks, etc., and fixing. Bends may also be included to pipes under 2-inch internal diameter.

Note that where a sink is on an upper floor (unless the waste delivers into a rain-water head) the vertical waste should be carried up as a ventilating pipe, and a branch joint taken; and if more than one sink delivers into the same vertical waste, an antisiphonage pipe will be necessary.

Bends to 2-inch diameter pipes and upwards.—*Number* as extra on the piping.

Holes through Walls, and Making Good.—*Number*, stating diameter of pipes, thickness of walls, and kind of facings, if any.

Enclosure underneath Sink.—Measure as previously described to cupboards, etc., and describe as "In dwarf enclosure."

Ironmongery to Sink.—*Number.*

Deal Top.—*Number* and describe, stating size.

Draining Boards.—*Number* and describe. If supported on bearers plugged to the wall, include them and state their size.

Attendance.—*Number* the sinks for Joiner's attendance, as, *e.g.*:—

	3/		Joiner attend Plumber to sink.

Stoneware Sinks.—*Number*, and state size and quality, and include half-brick bearers in cement, or iron brackets, etc., as the case may be.

Brass Washer and Waste and Joints to Stoneware and Lead Trap.—*Number.* If with cobweb grating, include it.

Trap, Lead Waste, etc.—See under Leadlined Sinks.

Vertical floated Face for Tiles.—*Measure per foot super.*, and describe as in small quantities.

Wall Tiling over sink.—This may be taken out in detail and described as in small quantities over sinks, but is much better *numbered* and fully described, stating size, etc., as, *e.g.*:—

	1/		Tiie lining over side and end of sink, total length 6.0 × 1.6 high, with Maw & Co.'s tiles, p.c. 10s. per yard at manufactory, and including angle tiles, and all cutting and waste, and making good edge of plaster to same.

Draining Board.—As previously described to Leadlined Sinks.

Attendance.—Ditto.

Lavatories

Basins complete with Valves and Wastes.—These are generally selected from a trade list. If in a range, the cast-iron underframes will also most probably be supplied with them. The top may or may not be included. If it is not included, *number* it and describe, stating size and method of fixing. Include the rounded edge, quadrant corners, etc., and the perforations, stating how many. Take the plinth *per foot run.* State size and how fixed, and *number* the mitres, returned ends, etc.

Include packing, carriage, and fixing with the apparatus, and also all connections to pipes.

Single Lavatory Basins.—*Number.* State catalogue number or p.c. value, and add for packing, carriage, and fixing, etc., as just described. Measure deal bearers, etc., as previously directed; also the enclosure underneath.

Traps and Pipes.—Measure the traps and the overflow, waste, and ventilating pipes as described under Sinks. The same remarks as to antisiphonage will apply here. *Number* the branch joints as they occur.

Wire Balloon Covers to top of ventilating pipes. *Number.*

Holes through Wall and Making Good.—As before described.

Attendance.—*Number*, as "Joiner attend Plumber to lavatory," or "lavatory range." If the latter, state how many basins.

Baths

Bath.—*Number* the baths complete, with valves and waste. State number in trade catalogue (or give p.c. value, and add profit and carriage); and include fixing and all connections to pipes.

Deal Cradle.—If not a Roman bath, take deal cradle. This is a *numbered* item.

Traps, Overflow, Waste and Ventilating Pipes, Branch Joints, Wire Covers, Holes through Walls, etc.—As to Sinks and Lavatories.

Lead Safe.—Measure the lead *per foot super.*, and *bill by weight*, and describe as in Safes.

Bossed Corners.—*Number*, and state height.

Rebated Hole in Floor for Outlet.—*Number.*

Waste Pipe from Safe.—*Measure per foot run. Number* the tafted soldered joint to safe, and the brass or copper hinged back flap, and the hole through wall and making good; or, if it be a short length of pipe, it may be *numbered*, and the length stated, and all the foregoing items included.

Bath Top.—*Number* and describe, stating size, etc., and how fixed, and if with brass screws.

Skirting.—*Measure per foot run.* Include the grounds, and *number* the mitres, returned and rounded ends, etc.

Enclosure.—*Measure per foot super.*, and describe. If any portion is fixed with brass cups and screws so as to be easily removable, *number* it as extra on the enclosure, and state its size.

If there are doors in the enclosure, *number* them as extra, and measure the rebate and bead *per foot run*, and *number* the ironmongery.

Joiner attend Plumber to Bath.—*Number.*

Joiner attend Plumber to Safe.—*Number.*

Water Closets

Apparatus.—*Number* this complete. State name of manufacturer and catalogue number, or p.c. value, the description to run "and add profit, carriage, and fixing complete." Include the joints in the description.

Soil Pipe.—*Measure per foot run.* State the diameter, and if of lead, describe it as "drawn lead soil pipe equal in thickness to 8 lbs. lead," and include "tacks and fixing to hard-wood plugs in brick joints," or as the case may be. State if tacks are cast, and if with astragal, and kind of nails. If the soil pipe be of cast iron, state diameter and weight per lineal yard, and describe the fixing, etc. If it is to be coated with Dr. Angus Smith's or other solution, include it in the description.

Bends (to Lead Soil Pipe).—*Number* as "Extra for."

Branch Joints.—*Number.*

Bends (to Iron Soil Pipe).—*Number* as to Rain-Water Pipe.

Junctions.—Ditto.

Hood and Straps (to Lead Pipe).—*Number.*

Wire Balloon Cover (to Lead or Iron Pipe).—*Number*, and describe.

Hole through Wall and Making Good.—*Number* as previously described.

Brass Ferrule.—*Number*, and state size. Include joints to lead and stoneware pipes in the description.

Joint of Iron Soil Pipe to Drain.—*Number*, and describe.

Sets of Collars and Stays to Ventilating Pipes.—*Number* and describe. State whether to iron or lead pipe, etc., as, *e.g.*, "Set of two ½-inch diameter wrought iron stays, 4 feet long, and collar to lead ventilating pipe, and fixing to slated roof, including 6 lbs. lead, slate, and joints complete."

Antisiphonage Pipe.—*Measure per foot run*, and describe, including tacks and fixing. If 2 inches diameter or over, *number* the bends as "Extra for." *Number* the branch joints. *Number* and describe any special joints, such as those of lead to stoneware or iron.

Holes through Wall, etc.—*Number* as previously described.

Lead Safe, and Warning Pipe, etc.—*Measure* as described to Bath.

W.C. Seat to Pedestal Closet.—*Number* complete, and describe or state p.c. value.

Seat and Riser.—*Measure per foot super.* Where seat and riser are of different descriptions, keep them separate. Include deal framed bearers; or these can be measured separately, as previously described.

Hole cut and dished for Pan.—*Number.*

Hole cut and dished for Handle.—*Number.*

Flap and Frame.—*Measure per foot super.*, and describe. *Number* the hinges.

Skirting.—*Measure* as described to Bath Top.

Water-Waste Preventer.—*Number* this complete, with ball valve, and all inlet and outlet unions. State how many gallons, and give catalogue number or p.c. value. Include backboard and cast-iron brackets and fixing, and all joints to pipes.

Chain and Pull.—*Number*, and state p.c. value.

Short Length of Overflow Pipe.—*Number*, and state size and length, and include brass or copper back flap.

Hole through Wall.—*Number* as previously described.

Flushing Pipe.—*Measure per foot run*, including tacks and fixing (describe tacks).

Bends.—*Number* as before described.

Canvas and Putty Joint to flushing arm.—*Number.*

Brass Clips and Rubber Buffers.—*Number.* These are fixed on flushing pipes to receive the hinged seat when lifted up.

Paper Boxes.—*Number* and describe.

Joiner attend Plumber to W.C. . . . }
,, ,, to Safe . . . } *Number.*
,, ,, to W.W.P. Cistern }

Water Supply

Cisterns.—These are now usually of galvanised wrought iron, and should be *numbered* and fully described, stating capacity, thickness of metal, and how put together. Describe the angle-iron stiffeners and rods. Include the bearers in the description, and state height of hoisting.

If a lead safe be specified under the cistern, it will most probably require a deal tray like a shallow leadlined sink, and will be similarly measured, except that the sides or rims, being only 4 inches high, will be taken *per foot run*, and bearers should be included in the description of bottom. Take the lead

lining as described to Safes, but take in addition copper nailing to edge.

Cistern Enclosure.—*Measure* as previously described to similar items. Include backings.

Cistern Covers.—*Number* and describe.

Hole through Enclosure and Make Good.—*Number.*

Drill Cistern.—*Number.*

Brass Union and Fly Nut with Screw Cap and Lining.—*Number.* State size, and include joints to galvanised iron cistern and lead pipe.

Lead Overflow Pipe.—*Measure per foot run.*

Hole through Wall and Make Good.—*Number* as previously described.

Or, Hole through Slated Roof for passage of lead pipe (stating size), including 5 lbs. lead, slate, and tafted soldered joint, and make good. *Number.*

Brass Back Flap.—*Number.* State size.

Opening up Roadway, tapping main, fixing ferrule (state size), and making good to the satisfaction of the local authorities, or pay them for doing the work and pay all fees.—*Number.* Next measure the piping *per foot run.* The weights of all the different sizes and classes of pipes may be stated in the Preamble or tabulated to save repetition. State diameter of pipe, and include joints, wall-hooks, tacks, and fixing in the description. Bends are also included to pipes under 2 inches internal diameter. To pipes of 2 inches diameter and over, number the bends and describe as "Extra for." *Number* the branch joints, and note that a branch joint is described by the size of the larger pipe. For example, the branch joint of ½-inch to 1-inch pipe would be a 1-inch branch joint. *Number* the soldered dead ends. Take the drilling to cisterns and the unions as they occur. Take the piping, etc., in the following order:—

Supply Pipe and laying in and including rough deal trough, and covering with pitch, or as the case may be.

Stop Cock and Key and cast-iron box let into pavement, including joints to lead pipe and making good.—*Number.* State size and quality.

Narrow Trench for Pipe.—*Measure per foot run.* State depth or average depth, and include filling in and ramming in the description.

Rising Main.—*Measure per foot run.*

Brass Screw-Down Stop Cock and Joints to Lead Pipe.—*Number*, and state size.

Note.—The quality and description of the various cocks may be stated at the head of Internal Plumbing, to save repetition.

Short Length of ½-inch Pipe, with branch joint to 1 inch (or as the case may be), and a ½-inch brass screw-down bib cock and all joints to empty rising main.—*Number.*

Hole through Cistern Enclosure and Making Good.—*Number.* State size of pipe.

Drilling Cistern.—*Number.* State size of pipe.

Brass Union and Fly Nut, with Screw, Cap. and Lining and Joints to Iron Cistern and Lead Pipe.—*Number.* State size.

Brass Ball, Valve, and Copper Ball Float and Joint.—*Number.* State size and describe, and give name of maker.

Now take the branch pipes (if any) direct off rising main, and follow them up to the various draw offs, etc. *Number* the soldered branch joints, soldered dead ends, and brass bib cocks and joints as they occur. Now take the services from the cistern, starting with the hole through enclosure, drilling cistern and brass union, following on with their branches to the various points and fittings as last described. Remember that the baths and lavatories, etc., were taken, including all joints to pipes, so that it is only now necessary to measure the pipes up to them.

Pipe Casing.—Measure this as it occurs *per foot run*, stating thickness and width, and if fixed with brass cups and screws. Include the wrought rebated and beaded grounds in the description, and state their size, and if plugged. If the casing is boxed it should be *measured per foot super.*, stating the thickness, etc., and including the grounds as above described. It is often difficult to trace from the drawings the exact amount of pipe casing that will be required, and in such a case it is usual to mark it "Provisional."

Attendance.—Unless all the cutting away for pipes and making good has been measured, a clause to cover this must be inserted. It is usual, however, in any case to measure the holes through external walls and making good, so that the clause should read somewhat as follows:—

"Attend upon, cut away for, and make good after Plumber in all trades (attendance to apparatus and holes through *external* walls, and making good previously measured)."

Hot-Water Service

Cylinder.—*Number*, and fully describe, including the flanged and riveted connections for pipes. State capacity in gallons. Include T-iron bearers cut and pinned to walls, and fixing complete.

Lead Supply Pipe.—Measure as previously described for lead pipes, starting with its branch joint or connection to cold-water cistern, as the case may be.

Brass Screw Union, with Screw Cap and Lining, and Joints to Lead and Iron Pipe.—*Number*, and state size. This for the connection of cold supply to cylinder.

Brass Stop Cock and Loose Spanner and Joints to Lead Pipe.—*Number*, and state size.

Flow and Return Pipes.—The iron piping is usually measured *per foot run*, including all back nuts, +'s T's, bends, elbows, etc., and wall-hooks and fixing complete; and a clause to this effect is inserted in the Preamble at head of "Hot-Water Service." The description and quality of the pipes and fittings also

occurs in the Preamble, so that the description in the Bill is almost limited to sizes.

Start with the safety valve, which *number* and describe, and include joint to boiler. Then take drilling to boiler, and include flanged and bolted connections in the description. State size. Next take the flow and return pipes between the boiler and the cylinder; then the flow and return from and to the cylinder; then the steam pipe, and if carried through roof, *number* the hole through roof, tinned length of pipe, lead slate, and tafted and soldered joint in one item. Next take the auxiliary flow pipe (if any), and then proceed systematically with the branches, following each to its termination, and *number* the bib cocks as they occur. Remember that the Bath and Lavatory were taken, including hot and cold valves and all connections to pipes, so that it is now only necessary to measure the piping up to them. Note carefully on the dimension sheets the position of each length of pipe as it is measured, so that it can be readily traced at any future time and any variation adjusted. *Number* the stop cocks as they occur.

Attendance.—"Attend upon, cut away for, and make good after hot-water engineer in all trades."

Gasfitter

The gas company make the connection to their main, and carry the piping to the front boundary of the property, so that all work up to that point is usually embodied in a clause somewhat as follows:—

"Pay Company for opening up roadway and connecting up from main to front boundary of premises, including stop cock and key, and cast-iron box in pavement, and making all good to the satisfaction of the Local Authorities."

If the company is also to supply the meter on hire, this may also be included in the foregoing clause, and also all connections up to the meter.

Take a meter shelf. This is numbered, including gallows brackets, and plugging and fixing to wall. State size of meter.

If Meter is not to be supplied by the company, *number* it and state its size in number of lights, and note that it is usual to take a meter for about five-eighths of the actual number of lights required.

Short Length of Compo. Pipe and Connection to Meter and Main.—*Number.*

Stop Cock and Loose Spanner.—*Number*, including joints.

Piping.—The quality, kind of joints, etc., is described in the Preamble. State if it includes T's, elbows, diminishing pieces, etc. If these are not included, they must be *numbered.* Measure the piping *per foot run.*

Gas Fittings.—Usually a provision. *Enumerate* the articles covered by the provision, and let the description run: "and add profit, carriage, and fixing."

Roses.—*Number* and describe, or let the provision include these; also the ceiling plates for the Pendants.

Attendance.—"Attend upon, cut away for, and make good after gasfitters in all trades." If floor boards over gas pipes are to be fixed with brass cups and screws, state it here.

Bellhanger

Although the old bells and pulls are now almost entirely superseded by electric bells, a brief description of their measurement will be given.

The Preamble should contain a description of the bells, and their average weight, the kind, quality, and gauge of wire, if in concealed tubes, and whether the tubes are of zinc or copper. Describe also the springs and cranks.

Bells.—*Number* these, including wiring complete, and state the number of points they are to ring from.

Pulls.—*Number*, and state p.c. value.

Bell Boards.—*Number* and describe, and state for how many bells, and if indexed.

Attendance.—Clause similar to that for "Gasfitter."

Electric Bells

Describe fully the bells, wiring, indicators, battery, etc., in the Preamble, and state that the wiring is to include wood casings where requisite. *Number* the Bells, stating size and position; and how many points on each floor they are to ring, and indicate from, as, *e.g.*:—

Bill

			No.	1.	2½" bell in kitchen to ring and indicate from No. 3 points on ground floor and 4 points on first floor.				

Pushes.—*Number*, and give p.c. value.

Pear Pushes and Cord.—*Number* and describe, and give the length and quality of cord, and describe the hard-wood rosette; or give a p.c. value to include the whole.

Attendance.—Clause similar to those for "Gasfitter" and "Bellhanger."

Painting

Measure all painting, with the following exceptions, *per foot super.*, and *bill in yards.* State that it includes cutting in edges, or measure this *per foot run.* Make the following additions to the figures in the Joiner's Bill:—

For work with exposed edges, add one-sixth. For square, framed, or moulded work with exposed edges add one-fourth. Twice the figures in Joiner's Bill for work painted both sides, such as doors, etc., unless there

is a different description of painting to each side, in which case each must be taken separately. Keep iron and woodwork separate, and bill them under their several headings, as "Knot stop, prime and paint four oils on plain and moulded woodwork," or "Knot stop, prime and paint four oils, the last coat in parti-colours, on plain and moulded woodwork," or as the case may be.

Measure per foot run.—Eaves gutter in and out, rain-water pipe, iron railings, giving height and description, skirtings, strings of stairs, skylight rail and bar, wood cornices and mouldings, etc., billing articles of similar size and description together. Architraves may be measured *per foot run*, or *per foot super.*, the length by the girth; balusters *per foot run*, or *numbered*, and average length stated.

Number.—Rain-water heads, air gratings, etc. If painted both sides, state it. Keep separate two light and three light frames, and frames with transomes.

Door frames, counting two for one (one for outside and one for in).

Sash or casement frames, counting two for one (one for outside and one for in). Frames over 24 feet super. are called large; over 36 feet super., extra large.

Sash sheets (that is, each sash not divided by sash bars) counting two for one. Call those over 8 feet super. large; over 13 feet super., extra large. Sash squares, *billed in dozens*, counting two for one. Call those over 2 feet super., large. *Number* the sheets and squares of casements as to sashes, also number the opening casements for edges, or measure casement edge *per foot run*.

Number treads and risers of stairs both ends.

Number blacking stoves and ranges.

Painting may be taken at the same time the rest of the work is measured, the item for painting following each item to be painted, with a note of what additions are to be made, and if it is to be twiced. For example:—

6/	3.0 7.0	126.0	2". 4 P. m. b. s. door *and* 2/ + ¼ (4)

Note.—The sign (4) is always used to denote "four coats of oil colour."

The super. dimensions for painting are then abstracted into three columns, headed as follows:—

(4) on Plain and Moulded Woodwork

		Add ⅙		Add ¼ and 2ce.	

Or, the painting may be abstracted direct from the Bill into their similar columns. This, however, can only be done when the painting is all of the same value. When there are two or more different descriptions of painting it is necessary to note it on the dimension sheets.

CHAPTER V

SQUARING, COLLECTING, AND ABSTRACTING

(Contributed by W. H. Brown, F.S.I.)

Having completed the "Taking-off," the dimensions should be "squared" and entered in the squaring column in black ink. The squaring should then be checked by another person, and ticked in red ink where found correct. Where the checker does not agree with any of the results he should have his own figures checked, and the requisite alteration should be made in red.

In squaring there are many short methods which are learned by experience. A few such will now be explained, in the hope that they may suggest the lines along which others may be looked for; and they are valuable insomuch that every expedient which shortens or simplifies the operation of squaring also lessens the liability to error. The expedient capable of the most universal application is perhaps that of varying the order of the factors. By this means it is often possible to get rid of fractions and sometimes also to eliminate the inches at the outset; for example:—

$$\begin{array}{r} 3/\,4/\,3\cdot 6 \\ 2\cdot 3 \\ \underline{\cdot\ 8} \\ = 63'.0'' \end{array}$$

This means three times four times (or 12 times), a cube whose sides are 3 feet 6 inches, 2 feet 3 inches, and 8 inches respectively. By working in the following order the above result is arrived at without putting a figure to paper, namely:—

$$3 \times 8'' = 2'.0'' \text{ and } 2'.0'' \times 3'.6'' = 7'.0''$$
$$4 \times 2'.3'' = 9'.0''$$
$$7'.0'' \times 9'.0'' = 63'.0''$$

In cubing certain scantlings it is sometimes possible to find a single divisor which will give the required result in one operation. For example, any length of 4×3-inch timber can be instantly cubed by dividing by 12, because 4 inches $= \frac{1}{3}$ of a foot and 3 inches $= \frac{1}{4}$, and $\frac{1}{4} \times \frac{1}{3} = \frac{1}{12}$.

$$\begin{array}{r} \text{Thus: } 126\cdot 3 \\ \cdot\ 4 \\ \underline{\cdot\ 3} \\ = 10'.6\tfrac{1}{4}'' \end{array}$$

For similar reasons any length of 2×6-inch timber can be cubed by taking 12 as the divisor, and any length of 2×9-inch by taking 8 as the divisor. Again, in multiplying by $4\frac{1}{2}$ feet $\times$ 3 inches it is often more convenient to add $\frac{1}{8}$ and divide by 12.

$$\begin{array}{r} 24\cdot 0 \\ \cdot\ 4\frac{1}{2} \\ \underline{\cdot\ 3} \\ = 2.3 \end{array}$$

which is worked mentally thus:—24 feet 0 inches $+ \frac{1}{8}$ of 24 feet 0 inches = 24 feet 0 inches + 3 feet 0 inches = 27.0; which divided by 12 = 2 feet 3 inches.

It may be noted that this result, 2′ 3″, though universally called 2 feet 3 *inches* by those engaged in building operations, means 2 cubic feet and three-*twelfths* of a cubic foot; for according to the practical man, a foot contains 12 inches, whether it be a lineal, super., or cubic foot.

Duodecimals.—Squaring dimensions is always performed by duodecimals, of which the above examples are modifications. The system consists in taking 1 foot as the unit and dividing it into twelfths; in the same way as in the decimal system the unit is divided into tenths. Thus 10 feet $6\frac{1}{2}$ inches would read as $10 + \frac{6}{12} + \frac{6}{144}$ feet, and would properly be written 10′ 6. 6. Multiplication by duodecimals is performed as follows. When multiplying by feet the product will be in the same denomination as the figure multiplied.

When multiplying by 12ths (or "inches"), it will be moved one place to the right.

When multiplying by 144ths, it will be moved two places to the right; and by 1728ths, three places to the right, and so on.

For example, the process of multiplying $10 \cdot 6\frac{1}{2}$ by $8 \cdot 7\frac{3}{4}$ is performed as follows:—

$$\begin{array}{r} 10.6.\ 6 \\ 8.7.\ 9 \\ \hline 84.4.\ 0 \\ 6.1.\ 9.\ 6 \\ 7.10.10.6 \\ \hline 91.1.\ 8.\ 4.6 \text{ super.} \end{array}$$

For all practical purposes this would be called 91 feet 2 inches super., ignoring the last two figures, calling each twelfth part an "inch," and the $\frac{8}{144}$ of a super. foot $\frac{2}{3}$ of an inch. It is usual, however, to call everything an "inch" which is more than $\frac{6}{144}$ of a foot.

In the case of a cubic dimension, say, 10 feet $6\frac{1}{2}$ inches

× 8 feet $7\frac{3}{4}$ inches × 2 feet $6\frac{1}{2}$ inches, proceed as in the last example with the two first dimensions, arriving at the result of 91 feet 1 . 8 . 6 . and multiply this by 2 feet $6\frac{1}{2}$ inches, or 2 feet 6 . 6 as follows :—

```
 91 . 1 .  8 .  4 . 6
  2 . 6 .  6
-----------------------
182 . 3 .  4 .  9 . 0
 45 . 6 . 10 .  2 . 3 . 0
  3 . 9 .  6 . 10 . 2 . 3 . 0
-----------------------
231 . 7 .  9 .  9 . 5 . 3 . 0 cube.
```

This result would be called 231 feet 8 inches.

Although in practice the *system* of duodecimals, or division into 12ths, is retained, the actual working can usually be more expeditiously performed by splitting the 12ths up into fractions of a foot having 1 for their numerators. For example, 6 nches = $\frac{1}{2}$ a foot ; 9 inches = 6 + 3 inches = $\frac{1}{2}$ a foot + $\frac{1}{3}$ of 6 inches ; 8 inches = 4 + 4 inches = $\frac{1}{3} + \frac{1}{3}$ of a foot ; 7 inches = 4 + 3 inches = $\frac{1}{3} + \frac{1}{4}$ of a foot ; $4\frac{1}{2}$ inches = 3 + $1\frac{1}{2}$ inch = $\frac{1}{4}$ of a foot + $\frac{1}{2}$ of 3 inches ; and the foregoing example would be worked as follows, varying the order of the factors as previously explained. The result is a species of "Practice" as shown below :—

```
                                          8 . 7¾
                                         10 . 6½
                                        ---------
                                         86 . 5½
6″ = ½ a foot, that is ½ the top line =   4 . 3⅞
½″ = 1/12 of 6″ = 1/12 the last line  =     4⅓ nearly
                                        ---------
                              "A"        91 . 2
                                          2 . 6½
                                        ---------
                                        182 . 4
6″ = ½ a foot, that is ½ of "A"       =  45 . 7
½″ = 1/12 of 6″, that is 1/12 the last line =  3 . 9 7/12
                                        ---------
                                        231 . 8 cube
```

The example given is a very exceptional one, for the sake of illustrating the principle, as fractions of an inch rarely occur in the dimensions, except in the case of timber scantlings. They are, however, often unavoidably introduced in multiplying the first two factors of a cubic measurement together, but a little practice will soon teach the student to arrange his factors so as to avoid fractions whenever it is possible.

All dimensions, whether they have to be squared or not, should be carried into the squaring column, otherwise they are very liable to be overlooked when abstracting.

Where two or more consecutive dimensions of the same description occur they should be added up at the time of squaring. This saves the Abstractor's time, and space on the Abstract sheet. The person who checks the squaring should also check these totals, and remember to alter them when any of the dimensions comprising them have been found incorrect. All corrections made by the Checker should in turn be checked. The totals of similar consecutive items should be entered on the dimension sheets as shown in Fig. 32.

The Taker-off, when making collections for any of his dimensions, should do so "on waste," as it is called ; that is, in the description column, so that the method by which the dimensions has been arrived at can be readily traced at any future time.

The person who checks the squaring should also carefully check all calculations on waste, and see that the results are correctly carried to the dimension column. The following example (Fig. 33), shows how

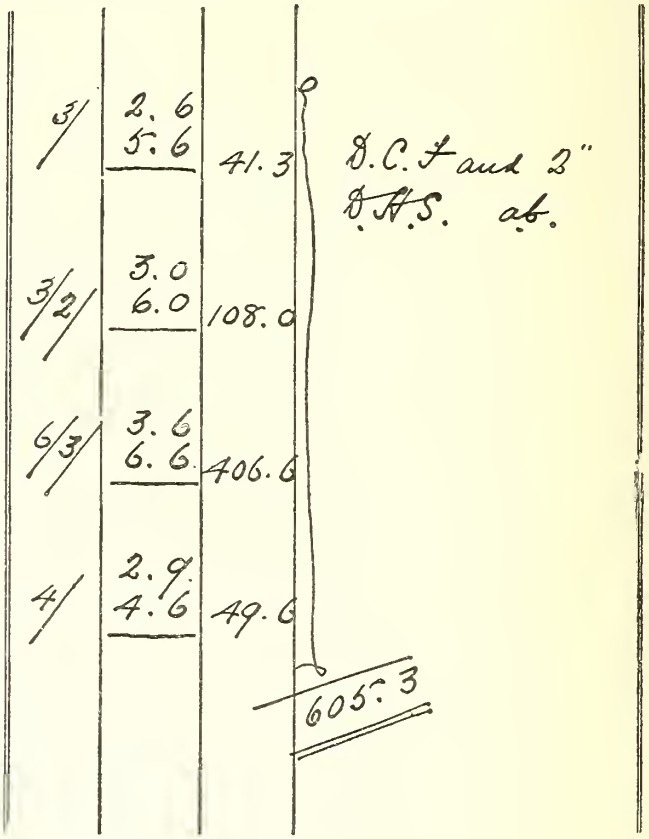


Fig. 32.

the walls of a room are collected for plaster and paper.

Both the Squarer and the Checker, in addition to the mere mechanical work of squaring, should keep a sharp look out for any slip on the part of the Taker-off. For instance, two dimensions only will sometimes be found to an item which should obviously be measured cube.

The Checker should be particularly careful not to omit any of the figures in the timesing column. It is astonishing how easy it is, when the Squarer has omitted one of these, for the Checker to fall into exactly the same error.

All the dimensions having been squared and checked, the next operation will be that of "Abstracting," which consists in transferring the squared dimensions to the

Abstract sheets, under their respective trades, and in the order in which they will appear in the Bill.

Abstract sheets are double foolscap size, ruled in vertical columns.

One of the most important rules for the beginner is to use plenty of paper. Ability to gauge how much space will be required on the various sheets for each particular job is only to be gained by practice, and the time and worry wasted on a cramped Abstract far outweigh the value of a little extra paper.

In a large office it is particularly necessary to write the name of the job in the middle of the top of each sheet; otherwise there is a possibility of one of them getting mixed up with the sheets belonging to another job.

The name of the trade should be written at the top left-hand corner of each sheet, and the sheets numbered in each trade; as, for example, "Bricklayer No. 1,"

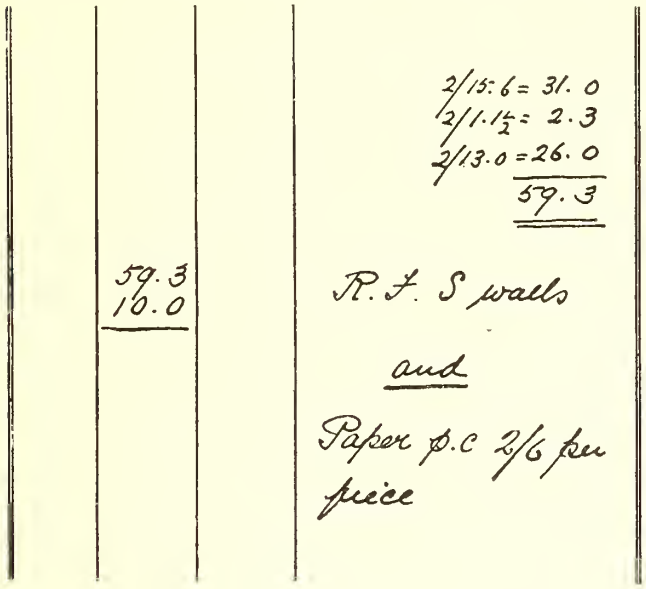


Fig. 33.

"Bricklayer No. 2," "Carpenter No. 1," "Carpenter No. 2," etc.

For the order of the Abstract, which, as before stated, should be that of the Bill, the student is referred to the Chapter on Billing.

The beginner will find it a good plan to take a separate sheet for each heading, such as "Supers.," "Runs," "Nos.," etc., as he can then easily add another sheet to either without destroying their proper order.

Having headed the sheets, look carefully through the dimensions and enter the headings of the principal items in each trade, and as many others as you can, leaving plenty of space between the items in which to introduce any others that may occur in their proper order.

Extreme neatness and clearness, especially in writing figures and keeping them in their proper columns, is essential at this stage, not merely for the sake of appearance, but in order to ensure accuracy. Long casts cannot be made correctly with any certainty if the tens occur beneath the units or the inches beneath the feet; nor if 3's are written so as to be mistaken for 8's or 5's.

Items that are intended to be "written short" in the Bill are entered on the Abstract, as in Fig. 34.

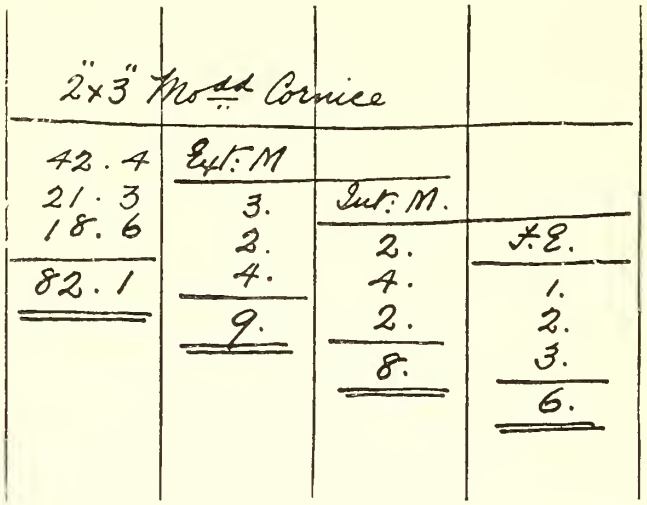


Fig. 34.

Each column should be followed by a column for deductions (when such are likely to occur), as in Fig. 35.

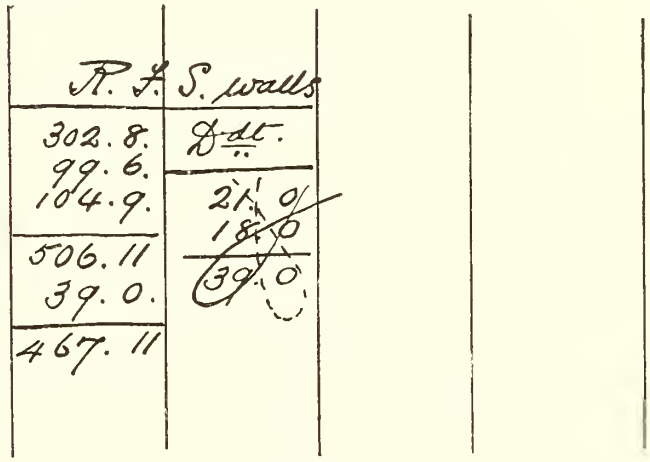


Fig. 35.

Whenever a total on the Abstract is carried to another column the original column should be crossed through as shown.

The person who checks the Abstract should check these transfers, ticking the transferred figure in *red*, and crossing through the original column in *red* as indicated by dotted lines.

As each item is transferred to the Abstract the Abstractor should run his pen through the *description* of the item on the dimension sheets. By running a line through the description of the item instead of

through the figures there is less liability to miss items where one dimension applies to two or more of them.

The person who checks the Abstract should tick the transferred figure on the Abstract in red, and run a *red* line through the item on the dimension sheet, parallel to the *black* line of the Abstractor. *Red* lines are represented by dots in the following example (Fig. 36):—

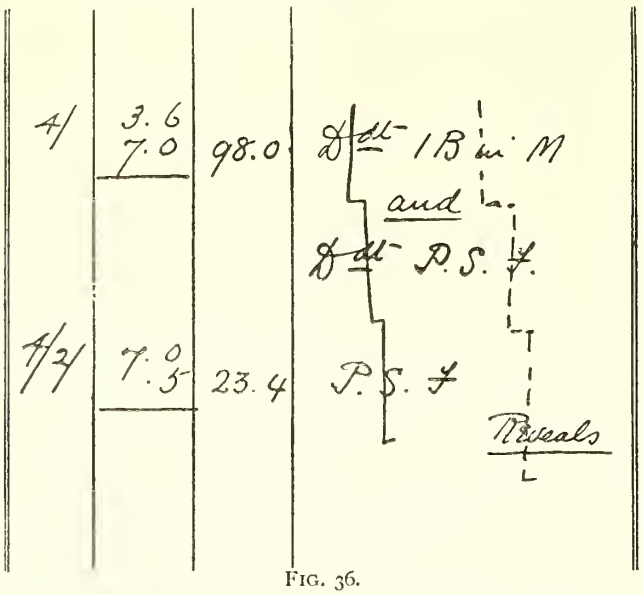


Fig. 36.

Abstracting may be done either trade, by trade, one trade being taken at a time; or the items may be abstracted consecutively, each being transferred to its proper trade as it is reached. The latter is the more usual and the better method. The Abstractor keeps the whole pile of Abstract sheets in front of him, turning to each one as he requires it. A little practice will enable the student to do this very rapidly, as he soon gets to know what items in each trade will appear on the left-hand side, and what on the right, and so turns back the top sheets either from the left or right-hand edge until he comes to the sheet he requires. When the carcase and finishings have been kept separate on the "Taking-off" he will only need to have the Abstract sheets of either the one or the other in front of him at one time.

Every item to go into the Bill should be noted in some form in its proper order on the Abstract. For example, in some few trades, such as Bellhanger and Gasfitter, an Abstract can often be dispensed with, and the items be billed direct; headings should, nevertheless, be made for these trades, and a note made under each in *red*,—"Billed direct."

The Abstract should start with an index, which, however, cannot be completed until the Abstract is finished.

Then should follow the "Preliminaries." If any or all of these are taken from the Specification, or from a previous Bill of similar work for the same architect, as is often done in practice, write the heading of "Preliminaries" just the same, and make a note under it, "Billed direct from Specification," or "Billed direct as usual." If some items have been entered on the dimensions, abstract these and then make a note, "Remainder billed direct from Specification," or as the case may be.

After the "Preliminaries" will come the "Spot items," if any; that is, items which the Contractor can only price after visiting the site.

"Excavator and Concreter," usually billed together, will follow. In a small job half a sheet will often be found sufficient for this. Surface excavation, although billed in yards super., is usually the first item, notwithstanding the general rule that cubic dimensions should come first. Then comes the digging to basement and carting away, divided into its several columns for the varying depths (as explained in the Chapters on "Taking-off"), each with its deduction column. This should be followed by "Excavation to basement and return, fill in and ram," "Surface trenches, and cart away," "Surface trenches, and return, fill in and ram," "Basement trenches, and cart away," and "Basement trenches, and return, fill in and ram," each divided into columns for the various depths, etc., as explained with reference to Basement digging.

The excavation should be followed by the items of "Dry brick rubbish spread and rammed under concrete," in separate columns for the various thicknesses, beginning with that of the least. Cube concrete in foundations, and super. concrete of various thicknesses under-pavings; Cube concrete filled in between rolled steel joists at various levels; then lineal and numbered items of labours, etc.

Note.—Where cement or granolithic paving is measured and described in one item with the concrete there will be lineal dimensions for forming gutters, etc., and numbered items of fitting and dishing around gulleys, etc.

Bricklayer.—This trade will take up several sheets. First, there will be the common brickwork, "Supers," "Runs," and "Numbers" forming the headings of sheets or of sets of columns. In the latter case the number of columns embraced by a heading should be indicated by arrow heads, as in Fig. 37, thus:—

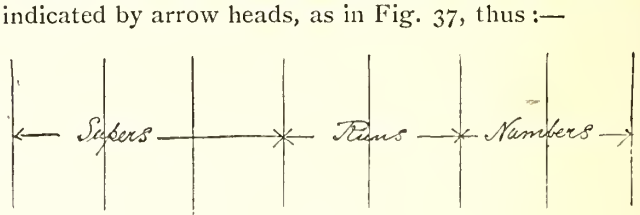


Fig. 37.

The supers. should start with three columns, the first for cube brickwork, the second for brickwork one-brick thick, and the third for brickwork one and a half brick thick, each with its column for deductions, and the whole comprised under the heading of "Reduced brickwork in mortar." Follow this with a similar set of "Reduced brickwork in Cement," or "Reduced

brickwork extra only in cement," according to the way in which it has been taken off.

All brickwork of whatever thickness will then be abstracted in one or other of these three columns. Sometimes it will be necessary to abstract an item under both the 1 B. and the 1½ B. columns. For example, 99 ft. 0 in. of 3 B. would be abstracted as 198 ft. 0 in. of 1½ B.; 64 ft. 6 inches of ¾ B. as 32 ft. 3 in. of 1½ B.; 75 ft. 6 in. of 2½ B., as 75 ft. 6 in. of 1 B. and 75 ft. 6 in. of 1½ B.; and so on. Brickwork which is taken off and abstracted per foot cube has ⅑ of its total deducted from it before being transferred to the 1½ B. column; and similarly 1 B.-work, taken out super., has one-third of its total deducted before transference. Thus this eventual total in the 1½ B. column is that of all the brickwork *Reduced* to a standard thickness of 1½ B. An example is given in Fig. 38.

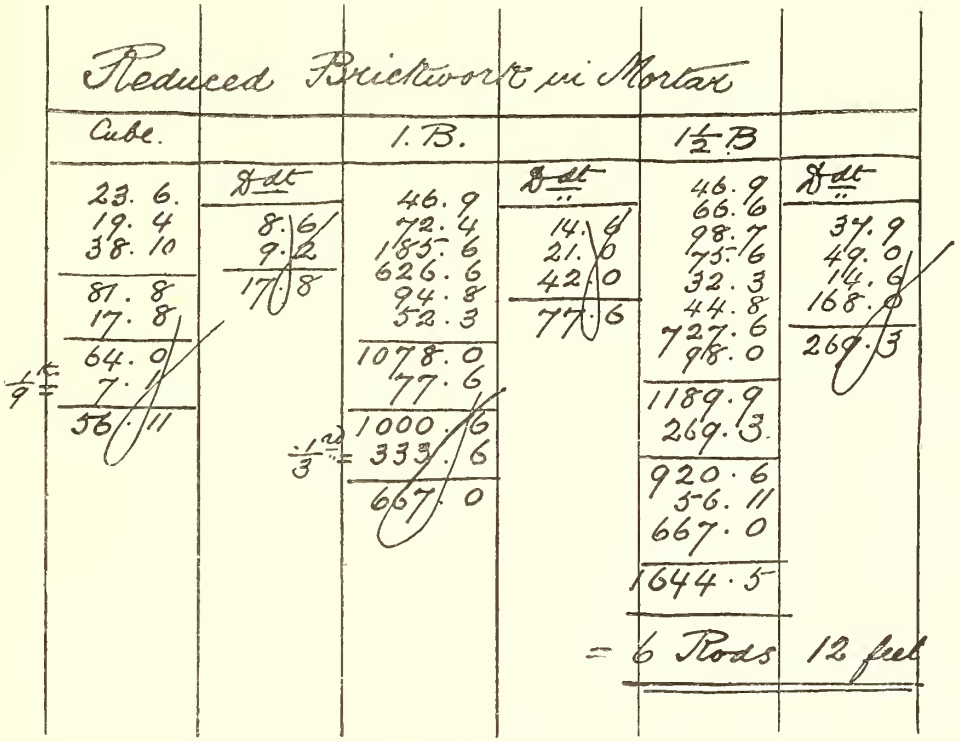


Fig. 38.

Follow the reduced brickwork with the other super. items of common brickwork, such as Half-brick partitions, Trimmer arches, Fair pointing, Limewhiting, Rough cutting, and Damp-proof course. After this will come the lineal dimensions, and finally the numbered items of common brickwork, commencing in each case with those of least value.

The next heading will be *Facings*, starting a fresh sheet of Abstract. Commence with the least expensive descriptions and work up to the most expensive, making a separate heading for each kind, and keeping every item appertaining to it under such heading. Commence each section with the super. dimensions of "extra for facing with" (here specify the kind of bricks) "and pointing with" (here describe the pointing). Follow on with the various descriptions of arches, the least expensive first, gradually working up to these of the greatest value. Complete the "Supers," and follow with the "Runs" and "Numbers." *Subheadings* should be made on the Abstract of "Supers," "Runs," and "Numbers," remembering to leave plenty of space under each, and when in doubt as to how much to allow start a fresh sheet.

The "Runs" should commence with lineal dimensions of labours, abstracted under a further subheading of "Labours."

Drains are either billed with "Excavator," which will then be headed "Excavator and Drains," or at the end of Bricklayer under a heading of "Drains in all trades," and are abstracted accordingly. The latter method is to be preferred. The only work in connection with drains actually done by the excavator is digging. The rules previously given will apply generally. If the manholes have been taken out in detail, they should be abstracted and billed under a subheading as explained in the Chapters on "Taking-off," otherwise they will be billed under "Numbers." Commence with the smallest drains, and divide each size into columns for its several depths of digging, as shown in Fig. 39.

Commence the "Numbers" with "Extra for bends" of the several diameters, the smallest first, following with "Junctions," "Double Junctions," etc., treating them in the same manner. After these come the numbered items of labours, such as "Ends of ventilating pipes made good to drain," etc. The last items

under "Drains" will be "Connection to sewer, and pay fees," an item for "Coring out Drains," and one for "Testing," unless these last two items have been included in the Preamble.

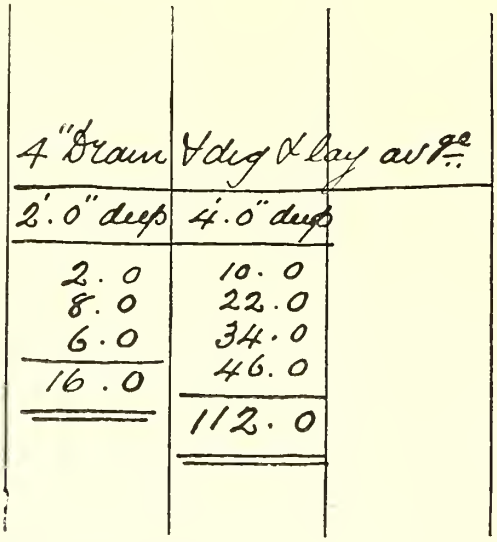


Fig. 39.

Mason

Divide the Mason's Abstract into sections for the different kinds of stone; observe the regular order of Cubes, Supers, Runs, and Numbers.

Where stone is billed as "stone and labour," items of the same thickness and width, commence with that of least value.

All items in short lengths, scantling lengths, etc., should follow immediately after the ordinary item of same size and description. Follow with numbers.

Where stone and labour are separately measured, abstract the cube stone first, following it with stone and labour in scantling lengths. Abstract the labours in the order of Supers, Runs, and Numbers, commencing each with the least expensive labour.

Slater or Tiler

In these trades the general rules previously given will apply. "Slater and Slate Mason" usually form one bill, but a separate heading should be made both on Abstract and Bill.

Carpenter

The rules previously given will apply to this trade. Under the cubes the several headings will be "Fir in plates and lintels," "Fir in ground joists and sleepers," "Fir framed in floors," "Fir framed in roofs," "Fir framed in roof-trusses," "Fir framed in partitions," "Fir framed in trussed partitions," etc. If each item has been cubed on the Dimension sheets, only two columns will be required under each of the foregoing headings on the Abstract, one of addition and one of deductions; if, on the other hand, the items are to be abstracted per foot run, and cubed on the Abstract, as suggested in the Chapter on "Taking-off," several

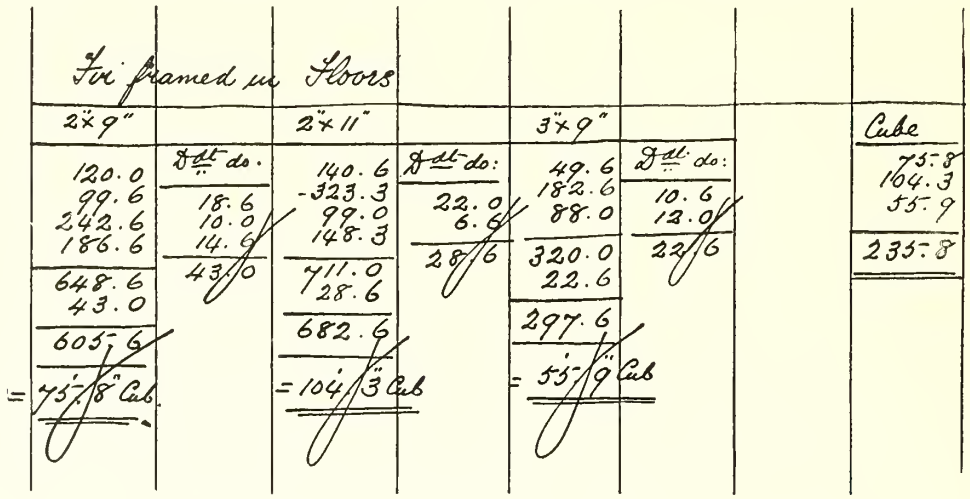


Fig. 40.

commence the cubic items with that of least value and work up to that of the greatest value; commence the super. dimensions with that of the least thickness, and each thickness with that of least value; commence the lineal dimensions with that of the least thickness, starting each thickness with that of the least width, and working right through that thickness until the greatest width is reached; then follow with the next thickness, and so on; where there are two or more colums will be required under each heading, and each scantling will have its own column of deductions. The wording of the heading will, however, show at once that the items are to be billed per foot cube. For example (see Fig. 40).

After the cube fir, abstract the Centering and turning-pieces under the heading of "Centering," in the regular order of Supers, Runs, and Numbers. Follow this with cradling and bracketing, and then the general

Supers, Runs, and Numbers, and finish with any items of fixing only ironwork, where the fixing is not included in the description of the item in the Smith's Bill.

Joiner and Ironmonger

Enough has already been said respecting the previous trades on the general principles of abstracting, and it will now only be necessary to notice the particular subdivisions of the remaining trades, together with any special points applicable to each.

The Joiner's Bill is usually the longest of any, and more demands are made upon the experience of the Abstractor than in any other trade. The beginner therefore will do well here to take particular heed of the advice previously given as to using plenty of paper, and starting a fresh sheet for each subdivision.

The principal subdivisions of the Joiner's Abstract in their proper order are—"Floors and Skirtings," "Sashes and Frames," "Doors and Framings," "Thicknesses," "Architraves and Mouldings," "Staircases in Deal," "Sundries in Deal," "Attendances."

All work in hard woods should be kept separate, and each kind abstracted under its own heading, following directly the similar heading in deal.

There are usually many items "written short" in the Joiner's Bill the method of abstracting which has been previously explained.

Floors and Skirtings.—Each description of flooring will be followed by its deduction column, and the similar description, "In small quantities in openings, including bearers," as in Fig. 41, for example.

1" St: Jtd Fl: in narr: widths wi: Splds head Rs:		
150. 0 218. 6 88. 4	Ddt do.	
	21. 9 6. 6	Do in openings incl: bgs
456. 10 27. 6	27 6	9. 0 6. 0 3. 0
429. 4		18. 0
= 4 Sqs:	30 ft:	

Fig. 41.

Skirtings.—Start with those of least thickness, and finish all widths of one thickness before starting the next. The mitres, fitted ends, housed ends, etc., should be abstracted with the skirtings to which they apply, and written short in the Bill.

Sashes and Frames.—Start with skylights, fanlights, and casements according to thickness; then take the sashes and frames according to thickness and description; all descriptions of one thickness consecutively, starting with the simplest.

Abstract any extra labours on the above items under this heading.

Doors and Framings.—Commence with the doors according to thickness, starting each thickness with the commonest kind. After the doors, abstract the framings in a similar order. Note that cupboard fronts are abstracted here, but the ends, unless framed, should be abstracted under "thicknesses." Any labours on doors and framings should be abstracted under "Sundries."

Thicknesses.—Under this heading should be abstracted all superficial and lineal items (except framings and mouldings) in various thicknesses of deal,

Attend Plumber to			
Baths	Sinks	W.C's	Cisterns
1. 1.	1. 2.	2. 1.	1. 3.
2	3	3	4

Fig. 42.

commencing with the "Supers" in the order, first of thickness, then of value, and following with "Runs," in order of thickness first, then of width, and lastly of value, beginning with the least thickness or value in each case. See under "Billing."

Note that both in Abstracting and Billing the least dimension of an item should always come first. The description should read, for example: "$1\frac{1}{2}$ by 6 inches twice rebated and twice beaded linings, tongued at angles, including backings," *not* 6 by $1\frac{1}{2}$ inches twice rebated," etc.

Thicknesses comprise such items as shelves, cupboard tops, cupboard ends, linings, window boards, solid door and casement frames, etc.

Architraves and Mouldings.—Commence with the least thickness and the various widths of that thickness, starting with the least. The mitres, fitted ends, etc., should be written short in the Bill, and be abstracted accordingly.

Staircases in Deal.—Abstract all the items in staircases under this heading, with "Supers," "Runs," and Numbers" in the usual order.

Sundries in Deal.—Commence with labours, those

of least value first; and follow on with all lineal and numbered items not referable to either of the other headings, adopting generally the rules as to order previously given. See also under "Billing."

Attendances.—These will constitute the last items on the Joiner's Abstract, and are entered as in Fig. 42.

Ironmonger

The items in this trade are mostly numbered. Keep iron and brass separate. Abstract and bill ironmongery fixed to hard wood under a separate heading. Make

Pr^s	Wrot: iron butts	
2½"	3"	4"
4.	2.	3.
2.	1.	1½.
6.	3.	4.
2.	1	6
14	9	14½

Fig. 43.

headings of the various items, embracing a sufficient number of columns for the various sizes of that item, as shown, for example, in Fig. 43.

Founder and Smith

Keep cast iron, wrought iron, and steel separate. Abstract all items of roof trusses under a separate heading.

Plumber

Keep External and Internal work separate.

External Plumbing.—Abstract the items to be billed by weight first. Lead in flats, gutters, valleys, and flashings are abstracted and billed together, and will form the first item, the other items of weight following in order of value, as shown below in Fig. 44.

Follow on with Supers (if any), Runs, and Numbers, commencing the Runs with labour items.

Internal Plumbing.—Commence with the items billed by weight, such as lead in safes. Lead in cisterns and

Middling	6d pipe	mid: tacks	4d 9.
½"	¾"	1"	1¼"
36. 0	84. 0	91. 6	22. 3
62. 6	13. 9	18. 6	42. 6
7. 9	30. 6.	40. 0	34. 0
106. 3	128. 3	150. 0	98. 9

Fig. 45.

sinks are abstracted and billed together. Follow on with runs of labours, then the various pipes according to size and weight, commencing with the smallest, as in Fig. 45.

Follow with *strong* lead pipe similarly set out. Soldered branch joints and soldered dead ends come next, according to size, the smallest first, as shown in Fig. 46; then the remaining Numbers, finishing with cocks of various sizes and descriptions, which are abstracted under a separate heading.

Milled 6d & lab: in flats, gutters, valleys & flashings

4 lbs		5 lbs		6 lbs		
33. 0	8 at 2	19. 0	8 at 2:	46. 6	8 at 2:	
25. 6	16 6	86. 2	10 9	58. 6	14. 3	671
48. 0		41. 3		75. 6	6. 9	765
77. 9		16. 7		89. 6	21 0	1494
184. 3		163. 9		270 0		2930 lbs.
16. 6		10. 9		21. 0		
167. 9		153. 0		249. 0		26 Cwt 0 qrs 18 lbs
4		5		6		
671 lbs		765 lbs		1494 lbs		

Fig. 44.

Commence under each heading with the items that are weighted out, those of least value first, and follow on with the Runs and Numbers.

Gasfitter and Bellhanger

Both these will be short Abstracts. The rules previously given will apply.

The last item will be the clause for tapping main, etc., and paying fees.

Plasterer

Abstract and bill each kind of plaster under a separate heading in the order of Supers, Runs, and Numbers, starting each with the items of least value.

Keep external work separate, and bill it last under the heading "Externally."

Soldered Br: fr			
½"	¾"	1"	1¼"
4.	3.	7.	2.
1.	8.	7.	3.
1.	2.	4.	3.
6.	13.	18.	8.

Soldered dead ends			
½"	¾"	1"	1¼"
9.	2.	3.	1.
1.	2.	6	4.
1.	4.	2	3.
11.	8.	11	8

Fig. 46.

Glazier

Abstract and bill the various descriptions of glass under separate headings according to value; for example:—

21 oz glass & glazed & w. 2 sts: n.s: fr Sup.			bo: do: cut & shapes. do.		
2. 0"	4. 0"	6. 0"	2. 0"	4. 0"	6. 0"
24. 0	38. 6	20. 0	92. 0	26 6	10. 0
37. 0	42. 0	48. 0	8. 0	18. 0	16. 6
61. 0	80. 6	68. 0	100. 0	44. 6	26. 6

Fig. 47.

Painter

See "Taking-off" for the different methods of dealing with this trade. Keep the various descriptions of painting separate in order of value.

Paperhanger

Abstract and bill the various papers according to value, the cheapest first.

The Abstract having been completed and checked, it has to be "reduced"; that is, the columns of figures must be added up, the deductions made, and the net totals reduced to the proper form for billing. For example, the excavation to trenches must be brought to cubic yards; the surface excavation to superficial yards; the common brickwork to rods of 1½ B. thickness, the principal items of Founder and Smith and Plumber to hundredweights, the Plastering and Painting to superficial yards, and the Paper to numbers of pieces. The form in which each item should be billed has been already noted in the chapters on "Taking-off," and will be further dealt with in the following Chapter on "Billing."

As previously stated, 12 inches are always reckoned to the foot, whether it be a lineal, superficial, or cubic foot, as this is sufficiently accurate for all practical purposes. It is scarcely necessary to say that superficial feet may be brought to superficial yards by dividing by 9, and cubic feet to cubic yards by dividing by 27.

Brickwork is billed by the rod, which is 272¼ feet super. 1½ bricks thick. The ¼ foot, however, is always omitted in practice, and the number of superficial feet of reduced brickwork is divided by 272 to bring it to rods.

To bring either the superficial or lineal dimensions in the Founder and Smith's Abstract to hundredweights it is only necessary to remember that cast iron 1 inch in thickness weighs 37.50 lbs., wrought iron 1 inch thick 40 lbs., and steel 1 inch thick 40.83 lbs. per foot super., from which it will be quite easy to deduce the weight of any other thickness, or the weight per foot run of a bar of any size. For example, the weight of a 2 by 1-inch bar per foot run will be ⅙ of the weight of 1-inch metal per foot super., 2 inches being ⅙ of a foot. A 2 by ¾-inch bar will be ¾ the weight of 2 by 1 inch, and so on. The weight of round iron can, of course, be ascertained from the above, but it would be rather a tedious operation. It is best to take it from tables, or the weight of 1-inch diameter may be committed to memory, and then. remembering that the areas of circles vary as the squares of their diameters, the weight of any other size can be found. Rolled steel joists are almost invariably selected from stock sizes, and their weight per foot run should be ascertained from the trade list; but be careful to consult the proper list, as the weights of the same sections vary with different makers, and many makers supply two different weights of the same section.

Cast-Iron Hollow Columns. Although these should be measured per foot super on the "Taking-off," the method of measurement and its reduction to weight will now be given.

Ascertain the width of the piece of metal forming the column, supposing it were unrolled and laid out flat, by means of the formula πd, d being the *mean* diameter (see Fig. 48) and π being taken as $\frac{22}{7}$. Having ascertained the width, multiply it by the height of column, and vou have the number of feet super. of cast iron of a given thickness. Add the cap and base plate (remember to deduct the hole in these) and the stiffeners measured as triangles.

Moulded caps, neckings, or bases should be judged and averaged as triangles, half-rounds, or other nearly

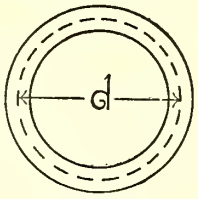


Fig. 48.

approximating figure, their length being ascertained by the formula πd. The superficial dimensions of the various thicknesses of metal should now be reduced to

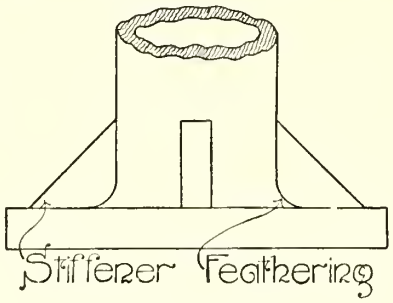


Fig. 49.

weight in pounds and added together. Add 2 per cent. of the total for featherings (see Fig. 49), and reduce to hundredweights.

Where bolts are billed by weight, the weight of heads, nuts, and washers may be ascertained from tables.

The weight of lead in lbs. is readily found by multiplying the total under each thickness by its weight per foot super. See example of abstracting under "Plumber." The weights in lbs. of the various thicknesses are then added together and reduced to hundredweights.

The principal items of plastering and painting should be reduced to yards, and the squares in painting to dozens.

It now only remains to reduce the superficial feet of paper to numbers of pieces. A piece of English paper is 12 yards long and 21 inches wide, which gives 63 feet super. per piece. The usual practice is to allow one piece in seven for waste, which is equivalent to deducting $\frac{1}{7}$ from each piece: thus 63 feet 0 inches minus $\frac{1}{7}$ of 63 feet 0 inches = 54 feet 0 inches. Therefore to reduce superficial feet to pieces, divide by 54, and call any fraction of a piece one piece.

French papers are usually 9 yards long and 18 inches wide = 40 feet 6 inches super. Deduct $\frac{1}{7}$ for waste, and this leaves a divisor of 34 feet 9 inches. Call this 35 feet.

The reduction of the Abstract should now be checked and ticked in red, and all will then be in readiness for Billing.

CHAPTER VI

BILLING

(Contributed by W. H. Brown, F.S.I.)

The Bill may be continuous—that is, all trades may be bound together in one document, the total of each trade being carried to a Summary at end; or each trade may constitute a separate Bill, or two or three trades may be bound together in one Bill. In this case each Bill will have its Summary, which will in turn be carried to a General Summary. For a small job the Bill is usually continuous, but for large buildings it facilitates the work of the Estimator to split it up into several sections. In such works as large Hospitals or Asylums it will often be most convenient to make a Blll of all trades (as a Continuous Bill is called) of each separate building, in the case of the main buildings; and to group the smaller and less important buildings together into one or more groups, making a Bill of all trades of each group. This method makes the adjustment of variations much simpler. The Bill should be headed somewhat as follows:—

ESTIMATE

For proposed house and stables at Chiddingstone, Kent, for Frederick Keen, Esq.

William Square, Architect,
216 Bedford Row,
London, W.C.

March 1905.

When the work is divided into several separate Bills, each should be similarly headed.

Head each trade with the number and name of the trade. The first heading will be as follows:—

Bill No. 1.

General Conditions and Preliminaries

Under this heading should be placed, first of all, such clauses of the General Conditions as may either directly or indirectly affect the cost, and other important conditions, such as the clause setting forth the method of making payments to the Contractor. It is scarcely possible to give the student any further instructions without giving a complete list of typical Conditions, and for this he is referred to any good London Bill of Quantities.

The Preliminaries will consist of the Insurance clause, and such items as the provision of water for the works, giving notices and paying fees, general attendance clause, scaffolding and plant, stakes and labour in setting out the works, office for clerk of works, sheds for materials, etc., latrines for workmen, hoarding, covering walls during inclement weather, casing up and protecting stonework and projections, making good injury to building from any cause, and making good pointing after frost, making good injury to adjoining buildings, shoring and strutting, keeping foundation free from water, all necessary watching and lighting, clearing away rubbish as it accumulates, scrubbing floors at completion, and leaving all clean and perfect, allowing facilities to other workmen employed upon the building, and allowing them the use of ordinary scaffolding and ladders, casing and protecting the work done by other tradesmen, and being responsible for and making good damage to such work; keeping works in repair for so many months after completion, and making good defects, and any other items not measured under any of the trades. The Preliminaries should also contain a clause requiring a detailed copy of the Estimate fully priced out and cast in ink to be deposited with the Architect, to form the basis for pricing any extras or variations on the Contract; and clauses setting forth the meaning of the letters P.C. (prime cost) and the method of dealing with provisional sums, and should finish with a clause as follows:—"Measurements in all trades are taken nett, and all openings (except flues) deducted."

If the Bill is for a country job, but has been prepared in accordance with London practice, it should be so stated.

For the particular wording of these clauses the student is again referred to a first-class Bill of Quantities or a well-written Specification.

Spot items should follow the Preliminaries. Unless there are a large number of them (as in an alteration job) they will not form a separate Bill; they consist of such items as necessitate a visit to the site before pricing, such, for example, as *Cutting back eaves of adjoining roof on north side of site, and making good roof to new wall, including* 1-*inch gutter boards and bearers and* 6 *lbs. lead gutter, with all requisite drips, etc., and outlet connected to existing rain-water pipe and* 4 *lbs. cover flashing* 6 *inches wide all complete, a length of* 35 *feet*, or "*Taking up, stacking, and relaying paving*," stating the length, etc.

Having completed the "General Conditions, Preliminaries, and Spot Items," the trades proper will commence with Bill No. 2.

The general rule is to commence each trade with the principal item in that trade; for example:—*Excavator*, digging; *Bricklayer*, rods of brickwork; *Mason*, cube stone; *Slater*, squares of slating; *Carpenter*, cube fir; *Joiner*, squares of flooring; *Founder and Smith*, cwts. of iron; *Plumber*, cwts. of lead; *Plasterer*, yards super. of render and set or render float and set, etc.

After the principal items keep as nearly as possible to the order of cubes, supers, and runs, dividing the trades up under subheadings as explained under "Abstracting."

It is the rule generally to bill the cubes in order of their value, the least valuable first; the supers. in order of thickness, and each thickness in order of value; the runs, labours first, in order of value, then materials and labour in order of thickness, each thickness in order of width, and items of the same thickness and width in order of value; the numbers, labours first, then labour and materials in the order first of size and then of value. Commence always with the smallest dimension or least value, as the case may be.

It is not usual to enter inches in the Bill. Six inches and over are billed as 1 foot, and anything under 6 inches discarded.

In items billed in yards cube, 13 feet 6 inches and over would be billed as 1 yard, and anything under 13 feet 6 inches discarded.

In items billed in yards super., 4 feet 6 inches and over would be billed as 1 yard, and anything under 4 feet 6 inches discarded.

In items billed by weight, anything under 1 quarter is billed either as 7, 14, or 21 lbs. For example, anything over 3 lbs., up to and including 10 lbs., would be billed as 7 lbs.; anything over 10 lbs., up to and including 17 lbs., as 14 lbs.; anything over 17 lbs., up to and including 24 lbs., as 21 lbs.; and anything over 24 lbs. as 1 quarter.

Each trade should commence with its Preamble, which should consist of a description of materials and labour and any other explanation which may affect the value of any of the items, or save lengthy descriptions, as, for example:—

BILL NO. 2.

EXCAVATOR, BRICKLAYER, AND DRAINS

Provide for keeping all excavations clear of water by baling, pumping, or otherwise, and include for all necessary planking and strutting to excavations and trenches.

Note.—When planking and strutting has been measured (as it should be except in a small job where the digging is shallow), the latter part of this clause will, of course, be omitted.

The concrete for foundations to be composed one part of blue lias lime to five parts of clean ballast and sand by measure well mixed dry, sufficient water added through a rose to bring it to the required consistency, and the whole thoroughly mixed in sufficient quantities only for immediate use; deposited in trenches and lightly rammed with a wooden rammer till the scum rises to the surface.

The cement concrete for floors, etc., to be composed of one part of Portland cement to five parts of clean ballast and sand, mixed as last described, and spread and levelled under floors and pavings.

The lime mortar to be composed of one part of grey Dorking lime to three parts of sand.

The cement mortar to be composed of one part of Portland cement to three parts of sand.

The Portland cement to be of the best quality from an approved manufacturer, and to weigh 112 lbs. per struck bushel.

The sand to be clean sharp river or pit sand.

The bricks, where not otherwise stated, to be approved hard well burnt stocks. Carefully wet all bricks before laying, and well flush up in mortar as the work proceeds. No bats will be allowed except where necessary for the bond.

The brickwork, except facings, to be executed in the best manner, and as known by the term "English bond"; no joint to exceed $\frac{3}{8}$ inch in thickness.

All excavation to include for grubbing up old foundations.

Note.—This last clause will only apply to the site of an old building.

The various subheadings in each trade should also be followed by any description which may save subsequent repetition in the Bills, or any note which may affect the value of any of the items, as, for example:—

Facings

All "extras" are extra only beyond the cost of rough brickwork first measured, unless otherwise described.

Each kind of facing should then have its own heading, followed by a description of the bricks and pointing, as shown in Fig 50.

Subheadings should be repeated at the top of each page of the Bill, followed by the word (*Continued*). Underline all headings and subheadings.

Subheadings adopted for convenience in "abstracting" have already been noticed. The following are adopted in the Bill in the order given:—

BRICKLAYER.—"*Facings*," with further subheadings of the several kinds of facings, see example above; "*Drains in all trades.*"

MASON. — "*Yorkshire stone*," "*Portland stone.*"

Under this heading is billed first the cube Portland stone, including hoisting and fixing at various heights as previously explained, and then the labours upon it. "*Portland stone and all labours.*" Under this heading is billed the Portland stone, which has been measured including labours. Follow in a similar manner with separate headings for any other kinds of stone.

SLATER.—"*Slate mason*" where any slate mason's work occurs, as in slate cisterns, urinal backs, and divisions, etc.

CARPENTER.—The only items usually billed under a subheading in this trade are those of centering, namely, "*Centering, including all necessary struts.*"

JOINER AND IRONMONGER.—"*Floors and Skirtings,*" "*Sashes and Frames,*" "*Doors and Framings,*" *Thicknesses,*" "*Architraves and Mouldings,*" "*Stairs in Deal,*" *Sundries in Deal.*" Separate subheadings for various kinds of hard wood should follow the similar subheadings in deal. "*Ironmongery of the best description, including screws and fixing to deal,*" "*Ironmongery of the best description, including brass screws and fixing to hard wood.*" "*Brass Ironmongery, including screws and fixing to deal.*" "*Brass Ironmongery, including screws and fixing to hardwood.*"

FOUNDER AND SMITH.—"*Cast Iron,*" "*Wrot. Iron,*" "*Steel.*"

PLUMBER.—"*Externally,*" "*Internally.*"

PLASTERER.—Subheadings for each different kind of cement, as, for example, "*Keene's cement on Portland cement grounds.*" Give a separate heading for external work.

PAINTER.—"*Two oils on iron after fixing,*" "*Knot, stop, prime, and paint four oils on wood,*" "*Knot, stop, prime, and paint three oils on wood, and grain and twice varnish,*" "*Four oils on Keene's cement.*" These descriptions should, of course, be varied to suit the circumstances.

The foregoing list gives the principal subheadings, but whenever repetition in the Bill can be saved by this means a subheading followed by a description should be adopted.

Sometimes a description only will suffice, as, for example, in the Plumbers Bill:—"*The following cocks to be Lambert's best high-pressure screw down.*"

In transferring the items from the Abstract to the Bill, care should be taken to notice if any item has been abstracted out of order, and to bill it in its correct place. Should an item get billed out of order, arrow it in to its right place in *red*, and the lithographer will make the correction.

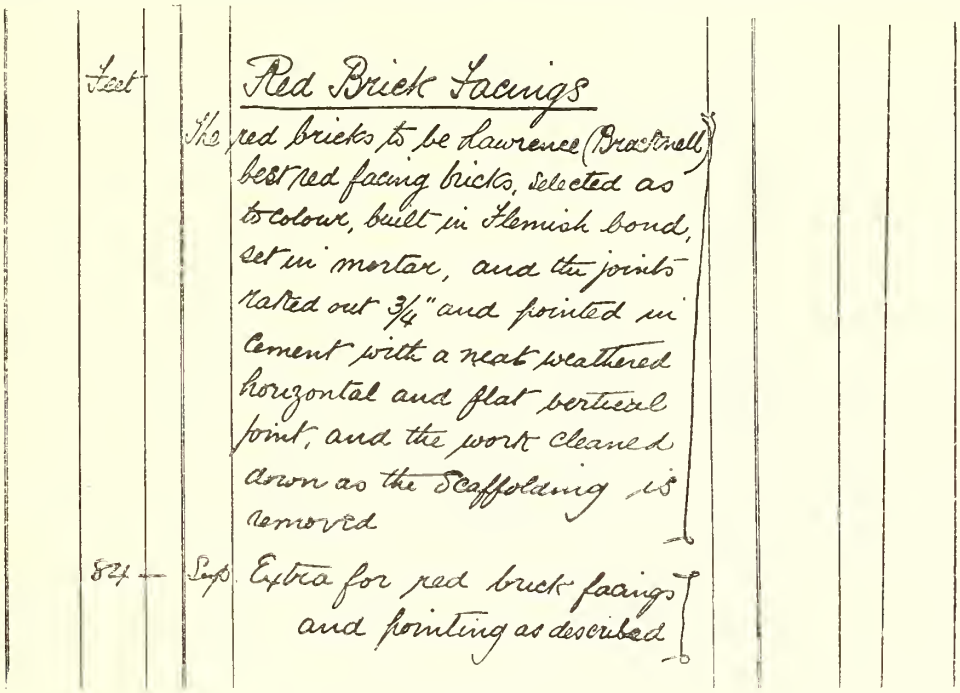

Feet
Red Brick Facings
The red bricks to be Lawrence (Bracknell) best red facing bricks, selected as to colour, built in Flemish bond, set in mortar, and the joints raked out 3/4" and pointed in cement with a neat weathered horizontal and flat vertical joint, and the work cleaned down as the Scaffolding is removed
824 — Sup. Extra for red brick facings and pointing as described

FIG. 50.

The method of billing is to *write* each item in the Bill with its proper description, and then cross it through in *black* ink on the Abstract. The person who checks the bill should tick each item in the Bill in *red* as he finds it on the Abstract, and then cross through the item in the Abstract in *red*; as each sheet of Abstract is finished, look very carefully down each column to make sure that no item has been missed, and tick the bottom of the column in *black*. The checker in turn follows the same course, ticking in *red* all as shown below (see Fig. 51), the dotted lines representing *red* ink.

Be careful in making the crossing through lines not to obliterate any of the figures, especially the totals.

Notice that the *looped* lines on the deduction mean

that the item is transferred to another place on the *Abstract*, and the *straight* lines on the main item mean that it has been transferred to *Bill*.

Next to the accuracy of the figures, the most important consideration in billing is the clearness and accuracy of the descriptions. It must be remembered that estimating usually has to be done under pressure of time, and the descriptions should be such as to convey

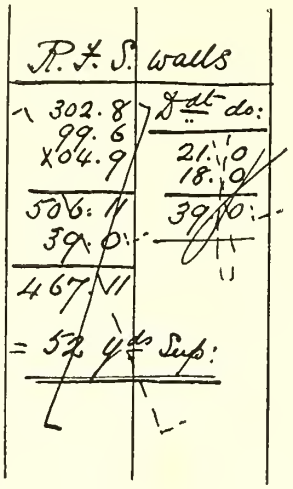


FIG. 51

definitely, to the mind of the Contractor or his estimating clerk, what and how much he has to do, and the information should be conveyed to him in the most concise form possible. Avoid all ambiguity, therefore. Items are frequently so described in a Bill of Quantities as to leave considerable doubt in the Contractor's mind as to what is intended to be included in the description, and the use of the word "including" will often make the meaning clear, as, for example:—

		No.	1.	Glazed stoneware sink, size 3′. 0″ × 1′. 9″ × 7″ deep, and fixing on *and including* half-brick bearers in cement.

Or, if the bearers are *not* included but are merely mentioned in the description to show the method of fixing, make the intention clear, as follows:—

		No.	1.	Glazed stoneware sink, size 3′. 0″ × 1′. 9″ × 7″ deep, and fixing on half-brick bearers (elsewhere measured).

In a long description it is sometimes necessary to say what is elsewhere measured, as, for example, (*bearers elsewhere measured*).

Be very careful in using the word *ditto* that there can be no mistake as to how much of the previous description it includes. Where an item varies in some respect from the previous one, it is often better to use the words "all as last described, but," etc., as, for example:—

	Feet.			
"A"	50	...	Sup.	Deal cased frames of 1″ inside and outside linings, 1¼″ pulley stiles, ⅜″ back lining, with beads and parting slips, and 3″ oak sunk, weathered, and check-throated sills, and 2″ ovolo moulded sashes, double hung with Samson patent lines and brass-faced axle pulleys, with steel axles and brass wheels and bushes and iron weights, the frames grooved all round for finishings . . . .
"B"	66	...	,,	Do. do. all as last described, but divided into small squares with 1″ ovolo moulded sash bars . . .

Where there are several varieties, as sometimes occurs in the case of sashes and frames, it is often necessary to refer to one or two of the main varieties by letter (see "A" and "B" in the last example), and then to describe those varying from these as: "*Deal cased frames, etc.*, all as 'A,' but," etc., or "*all as 'B,' but," etc.*, as the case may be.

When repeating an item, always repeat its dimensions.

	Feet.			
	109	...	Run.	1″ × 9″ ovolo moulded skirting and grounds fixed to partitions .
	150	...	,,	1″ × 9″ ditto ditto and ditto, but plugged to walls . . . .

Where items are billed run, always place the lesser dimension first in the description, as above,—never 9 × 1 inch ovolo moulded, etc. This facilitates observing the proper order as previously described.

Never use abbreviations in the Bill.

Having dealt briefly with all the processes necessary to produce a complete Bill of Quantities, a few words of advice to the beginner will perhaps not be out of place. First, as to scales; never use a scale with more than one scale on it, and let that be a single reading one. Nothing is more likely to lead to errors in measurement than the use of a scale which reads from both ends, and as the dimensions are never checked, errors are not likely to be discovered until the job is settled up. An ordinary architect's scale with a different scale on each edge is all very well *for its purpose*, because if the draughtsman were to attempt to use the wrong edge he would immediately discover his mistake; but

in measuring rapidly from a drawing and writing the dimensions down there is little or nothing to call attention to the error.

Where dimensions are figured, always use them in preference to scaling, but see that they are workable, and that they agree with the scale generally. Where dimensions follow naturally, as in the case of the linings and architraves of a door or window, measure only the main item as described under "Taking-off," and make the necessary calculations "on waste" for the remaining items.

Before starting to take off, have a good look through the drawings, and compare them and see that they all agree. Follow the chimney breasts up from floor to floor, see that there is room to get the flues up, and notice if any corbelling over is necessary for extra width. When the breast on an upper floor is wider than that below there is often a difficulty in getting the flues past the floors without the corbelling showing in the room below.

Read carefully through the Specification before starting to "take off," and notice if it differs from the drawings in any respect.

Before starting to "take off," prepare a sheet divided into two columns for "Notes and Queries" and "Replies." Make the notes and queries as they occur, and submit them to the Architect for settlement. If they are of a nature to keep until the "taking-off" is completed, one interview will settle the lot, but any important queries which may affect other items should be settled as soon as possible.

When "taking-off" openings, it is advisable to make some kind of mark in pencil on the drawings to show what openings have been dealt with, but make it as neatly as possible, with a soft pencil, as Architects often complain of the state of the drawings when returned from the Quantity Surveyor. One of the simplest ways of marking openings is to put a line right across the opening when you have deducted the brickwork, a line across the outside end of the first line when you have deducted the facings, a line across the middle when you have taken the sash and frame and finishings, and a line across the inside end when you have deducted the plaster, as in Fig. 52.

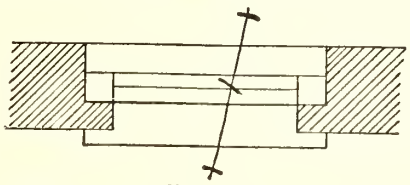


Fig. 52.

The following is a list of the usual abbreviations adopted on the Dimension and Abstract sheets :—

General

a.b. . as before.
b.s. . both sides.
Ct. . . Cement.
Circ. . Circular.
Co.. . Course.
Ddt. . Deduct.
diam. . diameter.
E.O. . Extra only.
F.E. . Fitted ends.
incl. . including.
irreg. . irregular
lab. . labour.
M. . . Mortar.
mi.. . mitre.
mo. . moulded.
m.g. . make good.
narr. wi. narrow widths.
o.s. . one side.
purp. made purpose made.
P.C. . Prime cost.
ro. . . rough.
semi. . semicircular.
segm. . segmental.
sht. lens. short lengths.
sm. quan. small quantities.
2^{ce} . . twice.
3^{ce} . . three times.
4^{ce} . . four times.
wrot. . wrought.

Excavator

R. F. & R. Return, fill in, and ram.

Bricklayer

Ar.. . Arch.
B. . . Brick.
B. & P. Bed and point.
Co.. . Course.
C. & P. Cut and pin, *or* Core and parget.
ch^{y} . chimney.
D.P.Co. Damp proof course.
F.C. . Fair cutting.
foots . footings.
rel^{vg} ar. relieving arch.
R.C. . Rough cutting.
R.W.P. Rake out wedge and point.

Mason

B. & J. Bed and joint.
Circ. F. Circular face.
Mo. F. Moulded face.
P.F. . Plain face.
P.S. . Portland stone.
R.S. . Rough sunk face.
S.F. . Sunk face.
Y.S. . York stone.
S.W.T. Sunk weathered and throated.

Carpenter and Joiner

Archve. Architrave.
bd.fl. . bead flush.
centg. . centering.
chfd. . chamfered.
D.C.F. deal cased frames.
D.H. . Double hung.
F.E. . Featheredged, or Fitted ends.
fr^{d} . . frames.
H.B.S. Herring-bone strutting.
not. mi. & retd. ends. notched, mitred, and returned ends.
O.S.W. & Chk. T. sills. Oak sunk weathered, and checkthroated sills.
o.g. . ogee.
$rebt^{d}$. rebated.
sq. . . square.
wrot. . wrought.
W.B. . Woodbrick.
X $tong^{d}$ Cross-tongued.

Founder and Smith

C.I. . Cast iron.
$galv^{d}$. galvanised.
h.n.& w. head, nut, and washer.
R.S.J.. Rolled steel joist.
R.W.P. Rain - water pipe.
W.I. Wrot. iron.

Plumber

C.C.N. Close copper nailing.
H.P. . High pressure.
jt. . . joint.
S.D. . Screw down
sold. . soldered.

Plasterer

ct . . cement.
distem. distemper.

L.& P.	Lath and plaster.
L.P. & S.	Lath plaster and set.
L.P.F & S.	Lath plaster float and set.
limewh.	limewhite.
P.C.	Portland cement.
R.	Render.
R. & S.	Render and set.
R. F. & S.	Render float and set.
wh.	whiten.
weath^{g}	weathering.

PAINTER

(2)	two oils.
(4)	four oils.
K.S.P.	Knot, stop, prime.
Var.	Varnish.

GLAZIER

B.P.P.	British polished plate.

Exceedingly valuable as these are, especially in the matter of saving time, to the experienced quantity surveyor, the beginner should adopt them gradually and with caution. It is better to work slowly than to run the risk of a mistake. Probably, also, though the above abbreviations are customary, no two surveyors use them all, or if so, not necessarily in the same sense; while the extremely practised man will originate others, which he will himself understand with ease, and use them freely. There is, in fact, no fixed rule in the matter beyond that the use of abbreviations is customary, and those in the above list, being in common use, are generally understood.

PART III

THE CONSTRUCTIONAL FINISHINGS OF A BUILDING

CHAPTER I

JOINERY WOODS, TOOLS, AND METHODS OF WORKING

(*Contributed by H. Kennard*)

The art of Joinery is that of converting timber from its rough state into the various fittings and finishings required to complete a building. In bygone years the joiners' art was a much more laborious one than at the present time. The invention and gradual introduction, from time to time, of labour-saving machinery has rendered the task of the modern joiner a vastly different one to that of his confrère of but a few decades back. Perhaps in no other department of construction has machinery superseded hand labour to anything like an equal extent. While this has undoubtedly largely affected the prices of joiners' work, principally of the commoner class, it has also had the effect of stimulating the mechanic to higher aims, and to-day specimens of workmanship can be obtained of a standard far and away above that of pre-machinery days.

While it is not intended to enter into a description of wood-working machinery, a short summary of the various kinds of wood, principally those used in joinery, may be found useful.

Woods

Woods are classified for all practical purposes into two divisions—Soft Woods and Hard Woods.

Soft Woods are generally used for all work which is to be painted or stained, and hard woods for polished or varnished work. The primary reason for this division is, of course, that of cost, but in cases where this is not the all-important consideration, great advantages are to be obtained in many ways by the substitution of carefully selected hard woods for many items usually executed in soft; and there is a growing tendency in this direction, more especially in better class work, so much so, in fact, that there are now in existence several firms manufacturing, almost exclusively, hard-wood fittings and finishings. The principal soft woods in use belong to the Pine family (natural order Coniferæ,) and are as follow:—

Northern Pine (*Pinus sylvestris*), so called from the fact of its growing in northern portions of Europe. It is imported mainly from Archangel, St. Petersburg, Onega, Wyborg, Riga, and several Norwegian and Swedish ports. It is very durable, of a pale yellow colour, has a strong resinous smell when freshly cut, and the annular rings very regular and distinct. Its easy and clean working qualities render it a great favourite.

Yellow Pine (*Pinus strobus*).—This is an American wood, chiefly exported from Quebec and St. Johns. It is sometimes called White Pine and "Weymouth" Pine. It is of a paler colour than the Northern Pine, with annular rings not so distinct. It is easily worked, but subject to dry rot, and has not proved a satisfactory timber in the variable climate of England.

American Red Pine (*Pinus rubra*).—This has a second botanical definition (*Pinus resinosa*). It is a favourite joinery wood, owing to its non-liability to warp or split, comparative freedom from knots, and cleanliness in working.

Pitch Pine (*Pinus rigida*) comes chiefly from the southern portion of North America. This wood is very largely used in heavy constructional work, on account of the length and size of the logs in which it can be obtained. It frequently possesses a most beautifully marked grain, and on this account would be in great demand for high-class joinery work were it not for the fact that it also possesses the pernicious characteristic of great and long-continued shrinkage, thus rendering it very unsuitable for decorative work. It is nevertheless largely used, and is exceedingly durable.

Kauri, Cowry, or Cowdie Pine (*Dammara australis*).

—An excellent joinery wood from New Zealand. It is free from many of the defects of other woods, due in a great measure to the gigantic proportions attained by the tree, it being no uncommon thing to obtain logs of from 10 to 12 feet diameter. It has, however, the unfortunate and exceedingly rare peculiarity of a perceptible shrinkage lengthways of the grain. It looks remarkably well polished or stained.

Californian Pine (*Sequoia sempervirens*).—This is the product of another of the giants of the vegetable kingdom, and, as the name implies, from California. It is sometimes called Sequoia, and sometimes Redwood. It is a soft, easily worked wood, having a somewhat coarse grain; and, although free from many of the usual defects, shakes, knots, sap, etc., it is exceedingly brittle, and consequently not at all suitable for framed work. It is used mainly for large panels, polished shelves, and in circumstances where it can be kept in the solid.

Oregon or Douglas Pine (*Abies douglasii*) possesses many of the characteristics of American Red Pine, but is slightly harder. It is very free from knots, but owing to the difficulty in working it to a good surface, consequent upon the extreme difference in texture between the spring and autumn growths of the annular rings, it is not classed among the best joinery woods.

Amongst the other soft woods not requiring special mention, the following are sometimes used, and may be noted in passing:—

Huron Pine (*Dacrydium franklinii*).—An exceedingly beautiful wood, indigenous to Tasmania. It possesses such very attractive qualities, from the point of view of the Australian joiner, that most of the output is absorbed by that country, but little finding its way to England.

Spruce (*Abies excelsa*), commonly known as White Deal, is used largely for domestic shelving and kitchen joinery, and finds a friend in the "jerry" builder, but owing to the swelling and shrinkage which it undergoes with varying temperature it is unsuitable for high-class joinery.

American Spruce (*Picea nigra*).—Sometimes called Black Spruce.

White Spruce (*Picea alba*).

Newfoundland Spruce (*Picea rubra*).

Cedar (*Cedrela odorata*), a soft, aromatic wood used largely by cabinetmakers for internal fittings.

The Hard Woods (non-resinous and non-coniferous) in most common use are:—

Oak (*Quercus*).—This is one of the most catholic of all trees as regards its distribution, being found in Europe, Asia, America, and Africa. Although botanically classified into numerous species, this wood, wherever grown, possesses to a very large extent the same qualities from a utilitarian point of view. Its general characteristics are hardness, increasing with age, toughness, elasticity; it is easily bent to curves when steamed, warps somewhat in seasoning, and tends to swell and shrink under climatic changes.

Its great strength and durability render it invaluable for many constructional purposes, in addition to which it is used largely in joinery for doors, dado, and wainscoting work, chimney pieces, furniture, etc. The presence of gallic acid in oak imparts to it a peculiar acrid odour, and has the effect of corroding iron, the iron at the same time staining the oak a dark brown. Ironwork should therefore be avoided in all oak work.

Mahogany (*Swietenia mahogani*).—The various kinds are named from the countries where they grow; Spanish mahogany, however, excepted. This is imported from Cuba and Jamaica principally. Other kinds are Honduras, Mexican, St. Domingo, Indian, and African. The different kinds vary somewhat in detail as regards colour, texture, and durability. Several woods masquerade under the name of mahogany which are not mahogany at all. Generally, however, the true wood is of a rich red-brown colour, often handsomely marked, durable when kept dry, but does not prove satisfactory when subject to alternations of wet and dry, takes polish well, and is used for interior decorative work.

Walnut (*Juglans*).—This is a wood of a purplish-brown colour, often with very fine markings. It is hard, strong, durable when kept dry, fairly easy to work, and takes an excellent polish. It is much in demand for cabinet and high-class joinery work, adding a richness to interior decorations.

Teak (*Tectona grandis*).—Although not possessing many attractions from a decorative standpoint, this is one of the most durable of the hard woods. For exposed positions, external doors, and window frames it is unsurpassed. Of a dark brownish-yellow colour, it is rather difficult to work. The grain being open, it is not a good polishing wood, but it is much better if oiled.

Beech (*Fagus sylvatica*).—This is not a joiner's wood, except to the extent that his planes and mallets are made from it. It is chiefly used in the manufacture of furniture.

Ebony (*Diospyros ebenum*) is one of the hardest and heaviest of woods, dead black in colour and difficult to work. It is little used for constructive purposes, but effective for decorative work when used in conjunction with other woods, and also for inlaid work.

Other hard woods, not, however, used to any extent in joinery work, are:—

Ash (*Fraxinus excelsior*). — Used largely for tool handles and for waggon and carriage work.

Elm (*Ulmus*). — A valuable wood for under-water work.

Jarrah (*Eucalyptus marginata*). — Used for sea work, piles, dock gates, etc.

Terms

Before entering into a description of the different tools used by joiners, and the various joints employed

by them, the following is a list of some of the terms and shop colloquialisms in general use:—

Stuff.—A comprehensive term, covering wood generally.

Kerf.—A saw cut, not through the wood.

Wrought.—Planed up. Sometimes written *wrot.*

Straight grained. — Having the grain free from twists.

Sticking a moulding means working it with a plane.

Quartering.—Small square timber, anything between $2\frac{1}{2}$ and $4\frac{1}{2}$ inches.

Rank stuff.—Coarse-grained wood.

Sound stuff.—Free from all defects.

Neat size.—An exact dimension.

Cast.—To twist or warp.

Check.—A name sometimes applied to a rebate.

In the clear. — An exact dimension between two points.

Core.—The chips cut from a mortise.

Cramping up. — Closing up framed work with a cramp.

Old woman's tooth. — Another name for a router plane.

Out of winding.—Perfectly true and free from twists.

Scribing.—Cutting the end of a moulding to fit the face of another moulding, or fitting the edge of a board to an irregular surface.

Shake.—A split along the grain of a board.

Wood screw.—Applied to screws used for wood to distinguish them from those used for iron.

Shooting.—Planing up the edge of a board.

Light size.—The distance between the interior edges of a frame.

Slack.—A slack joist means a badly fitting joint.

Rebate.—A square sinking on the edge of a board or frame. Pronounced as if spelt *rabbit.*

Planted.—Mouldings worked on separate pieces and fixed to framing are termed "planted on."

Quirk.—The narrow sinking at the side of a bead.

Arris.—The edge of a piece of timber, or any external angle.

Breaking-Joint.—When pieces of wood are joined together so that the joints are not in a straight line, they are said to break-joint.

Butt Joint.—A joint between two square ends.

Die Square.—Applied to timber the section of which is truly rectangular.

Doatiness. — A spotted or speckled appearance of timber, due to incipient decay.

Escutcheon.—The metal shield to a keyhole.

Donkey's Ear.—A form of mitre shoot.

Face Mark.—A pencil mark made on wrought stuff indicating the face.

Feather Tongue. — A tongue cut across the grain diagonally.

Horns.—The projecting ends of a frame.

Frenchman.—A sawing tool, shaped thus ∧, made with two boards.

Cross-Tongue. — A tongue cut straight across the grain.

Tools

The number of tools required by the joiner to enable him to deal with all the various kinds of work which come under his hand is by no means small, and when to the list of those which he can purchase is added the further list of those which he makes, including his workshop appliances, the total presents a somewhat formidable appearance.

The Saw in its several varieties may be considered as first on the list.

The *Rip Saw* is the largest kind, having coarse, widely spaced teeth, used for ripping or cutting timber along the grain. It is not much used by joiners now, most of the ripping being done by machine saws. The coarsest saw therefore usually possessed by the joiner is the *Half Rip Saw*, which is used for a similar purpose but has finer teeth; those in the rip saw being spaced 3 to the inch, and in the half rip, 4.

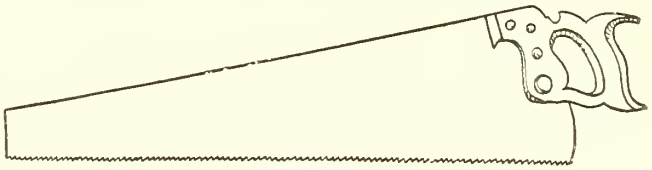


Fig. 53.

The *Hand Saw* (Fig. 53) is used for cutting across the grain. The teeth are rather smaller than those of the half rip, and are spaced about 6 or 7 to the inch. The finest kind of this pattern is called the *Panel Saw.* It is lighter than the hand saw, and has teeth spaced 9 or 10 to the inch. It is used for cutting the ends of panels, and where clean cutting is required.

The *Tenon Saw* is of a different pattern, having a narrow straight blade, stiffened by means of an iron or brass "back," and is used for cutting all shoulders and close-fitting joints. It cuts very "clean," as the teeth are spaced about 11 or 12 to the inch.

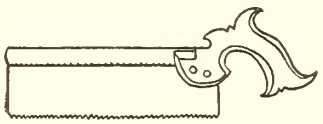


Fig. 54.

The *Dovetail Saw* (Fig. 54) is the finest used by the joiner. It is similar to the tenon saw in shape, but has an open instead of a closed handle, and is smaller, having not less than 15 teeth to the inch. It is used, as the name implies, for cutting dovetails and extra fine joints.

The *Compass Saw* has a very narrow blade, varying in length from 12 to 18 inches, and is used for cutting round curves.

The *Pad Saw* (Fig. 55), also a narrow-bladed saw, is principally used for cutting keyholes. It has quite a different handle to other saws, and the blade is mov-

able, so that it may be fixed to any desired length, being held in position by two set screws.

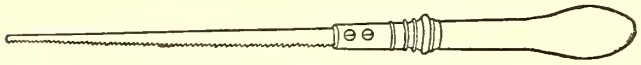


Fig. 55.

The *Bow Saw* (Fig. 56) is used for cutting very quick sweeps. It consists of a frame in which a thin ribbon saw, held by two handles, is stretched. It requires careful using to avoid snapping the blade.

Saws are sharpened with a file, that known as the "three square" file being used. The saw is held firmly in a pair of sharpening clamps, and the teeth filed up at the proper angle. Every alternate tooth can only be done from one side; then the saw is

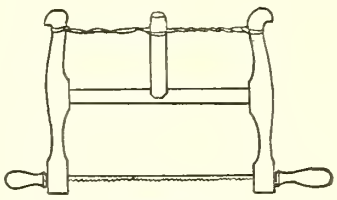


Fig. 56.

reversed and the other teeth completed. Saws must be "set,"—that is, have their consecutive teeth slightly bent in opposite directions, so that, in cutting, they may clear sufficient space to permit the blade to work freely. Considerable practice is necessary in order to sharpen and set a saw correctly, so that it may cut true and not "run" or twist in the cut.

Next in importance come Planes. These are used for producing a smooth and even surface upon wood. A *Jack Plane* is shown in Fig. 57, and consists of a beechwood stock, fitted with a handle and having a wide "throat," cut in the top and terminating in a narrow slot or "mouth" in the "sole." This throat is fitted with a double iron, consisting of a cutting iron and back iron, or cap iron, clamped together by means

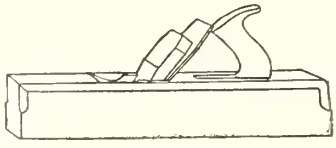


Fig. 57.

of a set screw. The iron is held in position with a wedge, and the amount of iron projecting above the sole can be regulated by this wedge; this varies in different planes. Jack plane irons are set rather coarse, as they are used for taking off the rough surface left from the saw. In the case of very rough or dirty surfaces, single iron Jack or "Scurfing" planes are sometimes used.

The *Trying Plane* (Fig. 58) is similar to the jack, but larger and longer. It is used in forming a perfectly straight and even surface. An extra long trying plane, called a *Jointer*, is used by some joiners for shooting long joints.

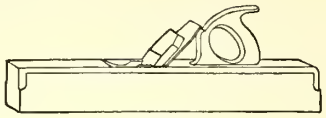


Fig. 58.

The *Smoothing Plane* is used for finishing and producing a smooth surface after the wood has been prepared by the jack and trying planes. Various patterns of smoothing planes are made, the ordinary all-wood pattern being the most common. These are sometimes fitted with an iron mouthpiece, which greatly preserves them, as otherwise, having such a small wearing surface, the mouth is soon enlarged when in constant use, and unless a narrow mouth be maintained, good work cannot be done. A metal smoothing plane is preferred by many; it is much heavier than the wooden stock, and consequently does not require the same amount of pressure to secure a good "bite" on the wood. The American pattern of smoothing plane consists of practically only a metal sole with handle and iron. It is a handy tool and easily worked, but, being light, it has a tendency to "chatter," and thus sometimes spoil a good surface.

The *Panel Plane* is similar in appearance to the jack, but made for finer work, and has a hard-wood slip fitted in and screwed to the off side angle of sole, which, when removed, exposes the iron, so that rebates and the splayed portions of raised panels may be worked close in to the angle.

The *Rebate Plane* is a small narrow plane having the iron the full width of the stock, and is used for cleaning up or forming rebates.

The *Badger Plane* is an improved form of rebate plane for wide rebates, having a skew mouth extending to the off side.

The *Shoulder Plane* is similar to the rebate plane, but is made of metal, has the iron set at a more acute angle, and is used for "trueing" shoulders after the saw.

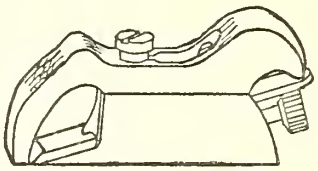


Fig. 59.

The "Bullnose" (Fig. 59) is a small rebate plane having the iron close to the front, so that stop rebates may be worked close up to the stop.

The *Compass Plane* is a smoothing plane with a curved sole, so that curved surfaces, such as the soffits of segment headed frames, may be worked. It is provided with an adjustable boxwood nosepiece, so that the sweep may be altered. The American type of this plane has a spring steel sole, actuated by a

screw, so that it can be made to fit either concave or convex surfaces.

The *Chariot* is a very small thumb plane with the iron reaching close to the front, and is used for cleaning off internal angles.

The *Block Plane* is like an enlarged smoothing plane with parallel sides similar to the jack. It is used in making joints and shooting mitres. The American pattern of this plane is of metal.

The *Chamfer Plane* has a sole formed to an internal right angle. It is used for forming chamfers, and has a movable block in the throat by which the depth of cut can be regulated.

The *Moulding* and *Grooving Planes* comprise—the *Sash Fillister* and *Side Fillister*, each provided with rising and falling stops and sliding fences. These two form a pair, for working on the off and near sides respectively, and are used for forming rebates or sinkings.

The *Grooving Plane* is used for cutting grooves across the grain. For this purpose it is provided with two cutters, a front or pilot cutter severing the cross fibre and preventing the edges of the groove being torn.

The *Plough* is an adjustable grooving plane, but only for cutting with the grain. It is provided with several different size irons, usually a set of nine.

The *Side Rebate Plane* has a vertical cutting iron, and is used for widening grooves.

The *Router* is used for deepening grooves and levelling the bottom of sinkings.

Bead Planes are used for working half-round mouldings or "Beads" on the edges of material; they run in sizes, by sixteenths of an inch.

Sash Planes are used for working the mouldings on sashes. There are several, each being named from the moulding which it works,—as "Ovolo Plane," "Astragal and Hollow Plane," etc.

The *Hook-Joint Plane* is made for forming the hook joint at the meeting styles of casement sashes.

Hollows and *Rounds* are used for forming either hollow or round members of mouldings. They are made in pairs for working either hand, and a complete set consists of eighteen.

The *Snipe Bill* and *Side Snipe* are narrow wedge-shaped planes, used in working mouldings under projecting members where other moulding planes will not reach.

Nosing and *Scotia Planes* are, as their name implies, for working the nosings and scotias on stair treads.

Fig. 60.

A tool of somewhat similar action to the plane is the *Spokeshave* (Fig. 60), which is used for smoothing edges of quick sweep. The iron type, with screw adjustment of the blade, is an improvement on the old wooden form.

Chisels are made in a variety of patterns, each pattern suited to a particular purpose, and having a wide range of sizes, in some from $\frac{1}{4}$ inch up to 2 inches.

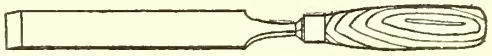


Fig. 61.

The *Paring Chisel* (Fig. 61) has a long, thin blade, and is used for paring surfaces, and, except when very narrow, has bevelled edges.

The *Firmer Chisel* has a shorter blade, and stouter, and is used with a mallet.

Fig. 62.

The *Framing Firmer Chisel* (Fig. 62), a still stronger make, usually has a ferrule at the end of the handle, so that it may be struck with the framing hammer without splitting.

The *Mortise Chisel* is a thick stiff tool used for cutting mortises.

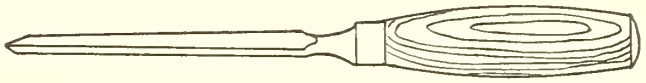


Fig. 63.

The *Sash Chisel* (Fig. 63) is a long narrow chisel, used for mortises in sash bars.

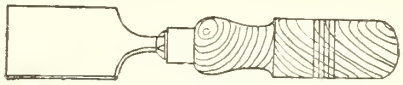


Fig. 64.

The *Sash Pocket Chisel* (Fig. 64) is a thin wide chisel, used for cutting pulley-style pocket pieces.

The *Drawer Lock Chisel* is a double-ended all-steel tool for cutting mortises in confined position.

The *Plugging Chisel* is an all-steel chisel, used for driving into the joints in brickwork previous to inserting wood plugs for fixing.

Fig. 65.

The *Firmer Gouge* (Fig. 65) is a hollow-faced chisel, having the ground bevel or "Basil" on the round side.

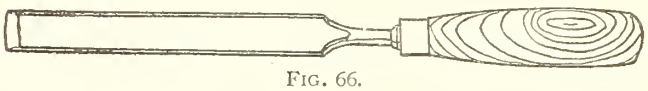


Fig. 66.

The *Scribing Gouge* (Fig. 66) differs only in having the basil on the inner or curved side.

The *Draw Knife* might be called a two-handled chisel. It is drawn towards instead of being pushed

from the workman as in the case of other chisels, and its use is for paring down edges or angles where there is too much to plane off and not enough to saw.

Boring Tools of a variety of patterns and a number of sizes of each pattern are also required.

Fig. 67.

The *Bradawl* (Fig. 67) is used for making holes in order to prevent nails or brads splitting the wood. It has a sharp chisel point, and is pressed into the wood with the edge across the grain.

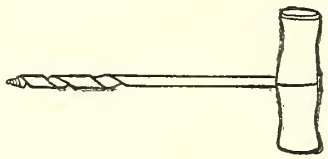


Fig. 68.

The *Gimlet* (Fig. 68) is used for making holes for screws. It is screwed into the wood and cuts a hole, removing the core. It is made in two patterns, "twist" and "shell." For larger holes a *Brace and Bit* is used. Of the several type of braces the two most generally used by joiners are the wooden stock, plated, and the iron stock with ratchet (American). The brace is worked by gripping its head with the left hand, and the hand pad with the right, and turning from left to right. The necessary pressure for driving the bit is obtained by the operator pressing either his head or chest on the left hand, the former usually for upright and the latter for horizontal boring. The ratchet attachment is useful in positions where there is not room to swing the hand pad completely round. By throwing the back stroke out of gear the bit may be driven by swinging the brace backward and forward in short strokes.

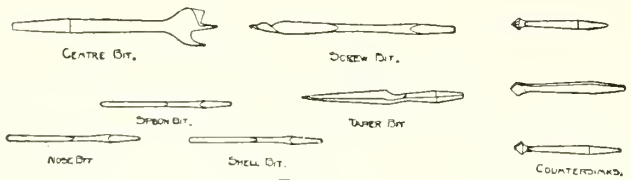


Fig. 69.

The different bits (see Fig. 69) used are—the *Centre Bit*, used for boring across the grain; *Twist Bit*, *Shell Bit*, *Nose Bit*, *Spoon Bit*, and *Taper Bit*, sometimes called a *Shell Rimer*. Patterns of these bits, with the exception of the latter, which is mostly used for enlarging holes, are made to cut either with or across the grain. A *Turnscrew* bit or screwdriver is sometimes used for driving screws. A special long bit, known as a *Sash Bit*, is used for boring sashes to receive the cords. Other bits used in the brace are *Countersinks*, used for enlarging or "countersinking" the tops of holes so as to let the heads of screws in flush with the surface. The three patterns in general use are the *Snail Horn Countersink*, for wood; the *Rose Head Countersink*, for brass; and the *Flat Head Countersink*, for iron.

Gauges are used for marking working lines at equal distances from the working face. There are two kinds

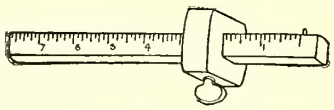


Fig. 70.

used, the ordinary *Marking Gauge* (Fig 70) and the *Mortise Gauge* (Fig. 71). The former has a single tooth and the latter two, one being movable, which is worked

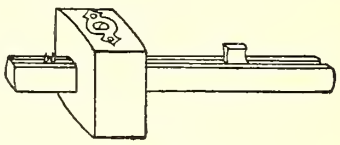


Fig. 71.

by a screw at the end of the stem, and may be set to any width of mortise. It is set by using the required mortise chisel as a guide, the teeth being adjusted so that the edge of chisel fits exactly between the points

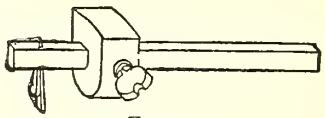


Fig. 72.

of teeth. A *Cutting Gauge* (Fig. 72) has a thin knife point instead of a tooth, and is used for cutting off thin parallel strips, usually for tongues.

Screwdrivers, of which three patterns are shown in

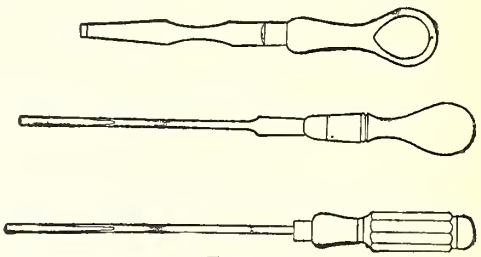


Fig. 73.

Fig. 73, or turnscrews, are used for driving screws, the round stem with oval handle being the most approved pattern.

A *Framing Hammer* and a *Bench Hammer* are used. The former, being heavy and double faced, is employed for knocking together large frames; and the latter, having a single face and flat pane, being used for all ordinary purposes.

The *Try Square* (Fig. 74), with wooden plated stock and steel blade, is used for testing angles and setting

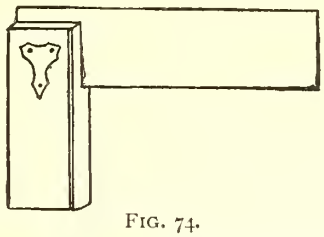


Fig. 74.

out shoulders, etc. Other fixed squares are the *Mitre Square*, used for marking mitres, and the *Set Square*, used for testing internal angles.

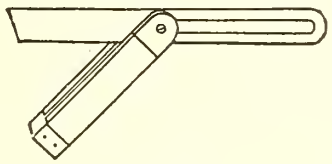


Fig. 75.

The *Sliding Bevel* (Fig. 75) is used for setting out and testing bevels. It has a sliding plate, and may be adjusted to any angle.

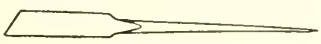


Fig. 76.

The *Marking Knife* (Fig. 76) has one chisel end and the other a sharp point. It is used for pricking off dimensions, marking shoulders, etc.

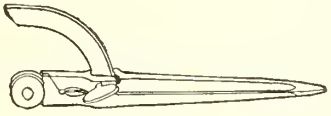


Fig. 77.

A *Two-foot Rule*, divided at least into eighths and sixteenths, is, of course, an indispensable adjunct.

Among other miscellaneous tools may be mentioned :—

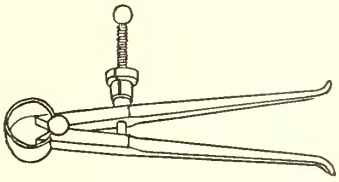


Fig. 78.

Compasses, both adjustable *Wing* (Fig. 77) and *Spring Dividers*.

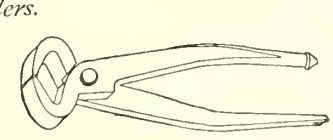


Fig. 79.

Callipers, for gauging widths and thicknesses. Those known as "Inside Callipers" are shown in Fig. 78.

Pincers (Fig. 79) are those known as the "Tower" pattern.

Fig. 80.

Spirit Level (Fig. 80) and *Plumb Rule*. Both necessary for the accurate fixing of work in position.

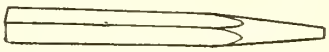


Fig. 81.

Punches (Fig. 81) are short steel bars for driving nail heads below the surface. A special *Handrail Punch*, with curved wide end, is used for tightening handrail bolts.

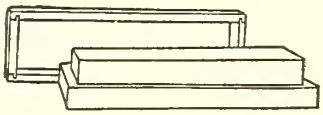


Fig. 82.

Oil Stone (Fig. 82) for sharpening edge tools.

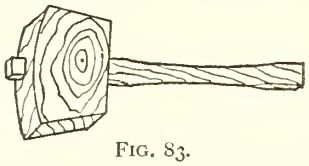


Fig. 83.

Mallets (Fig. 83) should be used for striking wood-handled chisels, etc., instead of hammers, and also for fitting together light framings.

Beam Compasses are useful for setting out large curves, although more frequently than not a light strip of wood with a bradawl for centre and a pencil at the required radius is made to serve all purposes.

In addition to the foregoing there are several other articles required by the joiner which, although they may hardly be classed strictly as tools, are nevertheless essential. They may be termed Workshop Appurtenances, for whereas the joiner has to provide all his own tools, these are common property.

The *Bench* upon which the work is done is a strongly made table, and is either "single" or "double" according to whether one or two men are accommodated. The usual size of a single bench is about 10 feet long, 27 inches wide, and 28 inches high. A double bench is the same height, but may run to 13 or 14 feet in length and 3 feet in width. It should be fitted with a bottom board of the full width, and also a large lock-up drawer. The top of a single bench is made of three 9-inch boards, the front 1½ and the others 1 inch thick, a double bench having the two outside 1½ and the two inside 1 inch thick, all grooved, tongued, and finished flush on top. A 9-inch board is fitted on each side close under the top, and should be perfectly square with it.

The *Bench Screw*, which is fixed near the end for holding the work, is sometimes of the old-fashioned pattern with wood screw and chock, but the type now generally used is the "Instantaneous grip" with metal jaws and screw. The *Bench Stop* is fixed for holding

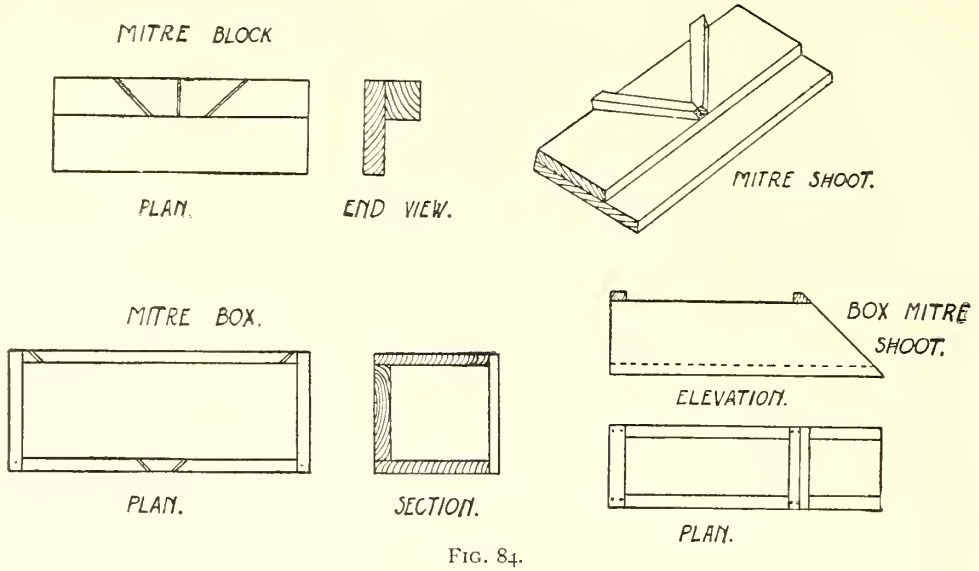


Fig. 84.

wood while being planed. It may consist of a wood block passing through the top, being raised or lowered as required and held in position by a wedge at the back, and having nails (usually three) fixed at the top and filed to chisel points, against which the wood is pressed; or special made metal stops may be fitted. These lie flush with the bench, and have a small plate with teeth which is raised or lowered by means of a screw.

A *Panel Planing Board* is a wide, perfectly true board, used for facing up panels and very thin boards. It is provided with screws driven nearly home, or small square hard-wood pegs as stops. It sometimes consists of a solid piece, and is sometimes framed and filled in with narrow widths to prevent casting.

Mitres are cut either on a mitre block or in a mitre box, illustrations of which are given in Fig. 84. There is also a *Mitre-Shoot*. The piece to be mitred is held in the angle of the block and sawn through, the saw running in the kerf in the block. It is then placed on the shoot and cleaned off with the block plane. The box mitre-shoot is used for large mouldings. Other forms of mitre-shoots are the "Donkey's Ear" and the "Screw Mitre-Shoot."

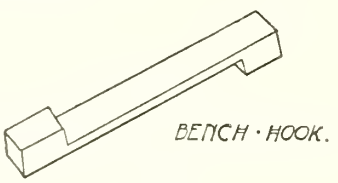


Fig. 85.

The *Bench Hook* shown in Fig. 85 is an appliance for holding the wood firmly while cutting shoulders, etc.

When framed work is glued up a proper *Gluing-up Bench* is used. This is merely a skeleton bench, having a middle rail with a sliding shoe, and a screw at one end. It is used for cramping the muntings when gluing up doors, the styles and all cross cramping being done with the ordinary joiner's cramp. Several sizes of these are generally provided for light or heavy work as required.

In addition to these, the joiner usually has several other devices of his own manufacture for gluing up and jointing, sketches of which are given in Fig. 86.

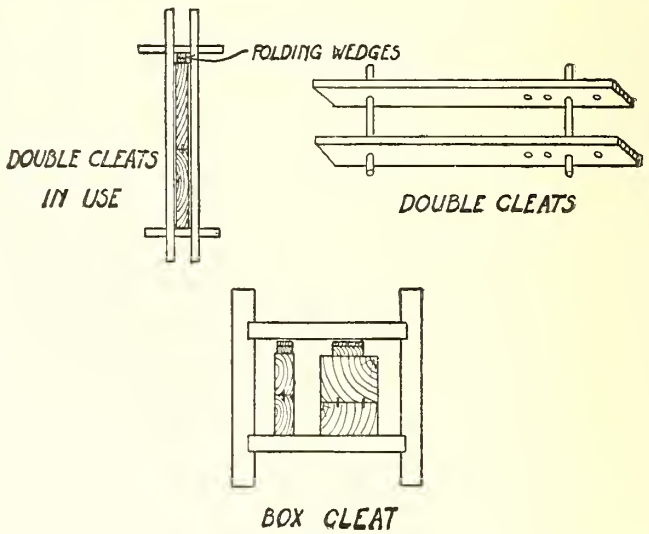


Fig. 86.

The *Box Cleat* is used for jointing wide stuff, or several narrow pieces may be put in together. Folding wedges are used to tighten up the joints. Double cleats are used for jointing boards, the sketch showing the method of using them. *Iron Cleats* are sometimes used instead of double cleats. They are very handy for small work, but when used for boards care must be

exercised in wedging or the work may buckle, being only guarded on one side instead of on both as with double cleats. Small iron cramps used on the bench for holding several pieces of wood while setting out, or holding moulds, are found very useful. A common type is known as a *G Cramp*, a smaller one being a *Thumb Cramp*.

Glue is one of the joiner's ever present needs. The best glues are "Scotch" and "Russian," which are fish glues. The proper method of preparing is to dissolve it in water and heat in proper glue pot, which is double, having an inner receptacle for the glue and an outer one for water only. It is better if dissolved slowly, in cold water for preference, and heated gradually, the hotter the more effective. No dirt or grease must be allowed to get in, and freshly made glue is better than that which is reheated, as with each heating a certain proportion of its adhesive properties are volatilised, and it is subsequently weakened. The best form of glue pot is one in which the inner pot is perforated by small holes round near the top. These allow the steam from the outer pot to pass over the glue, maintaining a moist heat and preventing the glue hardening and caking round the edges. Glue is sometimes "Doctored" in various ways, although generally to its detriment from a "sticking" standpoint. About $\frac{1}{2}$ an ounce of potash bichromate to half a gallon of glue will render it waterproof, but it should not be used on walnut or mahogany. Two ounces of quicklime in 2 pints of glue answers very well except for mahogany and oak. The drying of glue may be hastened by the addition of a little finely powdered chalk, and if it is desired to hide the joint as far as possible by colouring the glue to match the wood, a very small quantity of pigment may be added. Dark glue stains may be removed by a little oxalic acid, but dark glue should not be used, for the clearer and more nearly transparent the glue in cake the better.

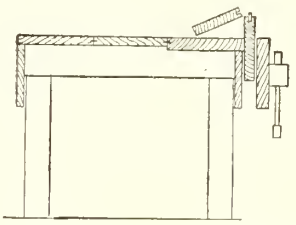
Glue should always be used as hot as possible, and in all gluing operations everything should be ready to hand, so that the work may be carried out speedily and without any delay. When gluing up a door, the wedges are all prepared and laid in readiness, the door is laid on the gluing-up bench and knocked apart, loose pieces resting across the bench to carry the styles and muntings. The tenons of muntings, and their mortises, are first glued, the latter with a *Mortise Stick* (Fig. 87), which is a wide thin piece of wood with several saw kerfs to hold the glue, and cramped to the rails as shown in the fixed cramp in bench being used. The mortises in styles and rail tenons are next glued, and the styles simultaneously knocked on and cramped, first across the middle, the wedges dipped in the glue and the middle rail wedged, the wedges being driven evenly and regularly. If one cramp is used it should be placed between the tenons; and if two, one on each side of the rail. The bottom rail is next cramped and wedged, and the top rail last. The outside wedges in the top and bottom rails should be driven slightly

MORTISE STICK FOR GLUING MORTISES

Fig. 87.

harder than the inside ones, so as to pinch the rail tightly against the shoulder of munting.

In making joints with long boards the method of procedure is as follows:—The edges having been shot true and out of winding and ploughed, one board is fixed in the screw, and the tongues fitted. These should fit easily but not loosely, and a bradawl driven in at each end, or a small stop nailed on the end of the groove, to prevent their being driven out when rubbing the joint. If bradawls are used they are then withdrawn sufficiently to release the tongues, which are removed and the groove nearly filled with glue, a glue spoon being used in preference to a brush. The tongues are then replaced and tapped in with a mallet, and the other board held in the position shown in Fig. 88. Both edges are then well glued with a brush, and the loose board turned over and placed in position. It is then gripped by the end, and with the aid of an assistant at the other end it is pressed firmly down and rubbed backward and forward in long strokes until the glue begins to stiffen and "drag." It is then brought to its proper position, the cleats put on and wedged and laid aside in an upright position to dry.



METHOD OF HOLDING BOARD WHILE GLUEING JOINT.

Fig. 88.

Joints.—The list of joints used in joinery, of which several are shown in Fig. 89, is an extensive one, and a combination of practical experience and theory enables the skilled mechanic to supply from his repertory a joint to meet the exigencies of every case. The simplest form of groove and tongue joint has been already shown. For wide edges double tongues are used, as shown at No. 1 in Fig. 89. Tongues should always be either "Feather" or "Cross."

All joints are designed to effect the rigid securing

together of two pieces meeting at some angle, the right angle being the simplest. The following are some of the joints employed:—

No. 2 is a *Square Joint*, and must be nailed.

No. 3 is a *Plain Mitre* and also requires nailing, or it may be secured by one of two methods, one being known as a *Slip Dovetail* and the other as a *Slip Key*. The former is done by cutting a dovetail notch in the angle and driving in a dovetail key, afterwards cutting off the ends, the latter by making a saw kerf and gluing in a thin piece of hard wood.

No. 4 is termed a *Box Rebate*, and is substituted for a mitre when a rounded angle is required. It is secured by nailing.

No. 5, a *Rebated Joint*, is secured by nailing.

No. 6 is a *Groove and Tongue Joint*.

No. 7 is another form of the same, with moulded edge to hide the joint.

No 8, *Return-Bead and Rebate Joint*.

No. 9 is used for jointing two pieces of unequal thickness, and is called a *Stopped Mitre*.

Nos. 10 and 11 are respectively *Lipped Mitre* and *Lipped and Tongued Mitre*. Both may be adopted for uniting unequal thicknesses.

No 12 is a *Tongued Mitre*.

No. 13 is a *Double-Tongued and Beaded Joint*. It should be glued and no nails shown.

No. 14 is an adaptation of the same joint to an obtuse angle.

No. 15 is a very useful joint, also for an obtuse angle. It is used in high-class work, is not difficult to make, and must be glued. It is called a *Double-Tongued Mitre*.

No. 16 is a *Rebated Mitre Joint* for obtuse angles. The angle may be moulded to hide the joint.

No. 17 is a *Lipped Mitre and Dovetail*, useful in cases where two pieces of different directions of grain meet.

No. 18 is a joint largely used in packing cases. It is machine made, very strong, and is called *Corner Locking*.

No. 19 is the ordinary *Packing Case* or *Box Dovetail Joint*.

No. 20 is a *Lapped Dovetail*, or *Drawer front* dovetail, used in constructing drawers.

No. 21 is a *Mitre* or *Secret Dovetail*, used for external angles in high-class work.

No. 22 is a strong common dovetail joint, known as *Cistern Dovetail*, chiefly on account of its being used in the construction of wooden cisterns.

No. 23 shows the dovetail joint adapted to obtuse angles.

No. 24 is a dovetail joint sometimes used in framing bearers. It is also adapted to framing sashes.

There are several forms of the mortise and tenon joint shown here. It may be noted in passing that when setting out mortises and tenons, lines indicating mortises should always be marked in *pencil*, while shoulders should be marked with a *knife cut*.

No. 25 is a *Slot Mortise* and tenon. It requires either pinning or screwing, and is only used in common work.

No. 26 shows the proper mortise and tenon.

No. 27 is a *Haunched Tenon*, a part of the tenon being cut away, the stump remaining at the root of the tenon being called the *Haunch*.

No. 28 shows a *Stump Tenon*, the tenon in this case being employed to keep the shoulder up, and the *Stump*, being much stouter, to take the strain.

No. 29 is called a pair of single tenons, and

No. 30 a pair of double tenons. Doors which are to be fitted with mortise locks should have the lock-rail framed in this way.

No. 31 shows a *Hammer-Headed Tenon*, used principally for framing posts to circular-headed frames.

No. 32 is a joint used for connecting transoms in wide framing. It is called a *Dovetail Tenon*. In fixing, the mortise must be made long enough to allow the tenons to pass each other. When lapped, the mortise is closed and the tenons secured with a pair of folding wedges.

No. 33 is a *Table* or *Taper-Haunched Tenon*.

No. 34, a *Tongued-Shoulder Joint*, is preferred by many to double tenons in thick framing.

No. 35 is a joint employed in high-class work when it is not desired that the end of the tenon should show through. It is called a *Fox Tenon* or *Fox Wedging*. It requires very careful fitting. The mortise is first cut to the proper depth, and uniform. The tenon must be cut slightly shorter than the depth of mortise, and must fit tightly at the shoulder, otherwise it may split when cramped up. The wedges should be of slight taper, planed smooth, and out of hard wood, the outer ones rather longer than the inner, and be just thick enough to split the tenon but not beyond the shoulder. When putting together, the mortise, tenon, and wedges are well glued and the joint cramped up steadily but *without stopping*.

No. 37 shows the method of fixing a *Dovetail Key*, which is put at the back of wide panels and dados to prevent casting.

Nos. 36, 38, 39, and 40 are other methods of obtaining the same result.

Nos. 41, 42, and 43 show three methods of keying up butt joints: the first, known as a *Dovetail Key*, or *Double Dovetail Key*; the second, a *Hammer-Headed Key*, frequently used in segment framing; and the third, a *Counter Cramp*, used for wide boards, stair strings, etc. To make this joint, three strips of wood are fixed across as shown, the outside pieces screwed to one board, and the middle piece to the other, key ways having been previously cut in each as dotted, that in the middle piece being fixed nearer the joint. Folding wedges are then driven through, and when the joint is up it is secured by screws driven in at the points marked ×.

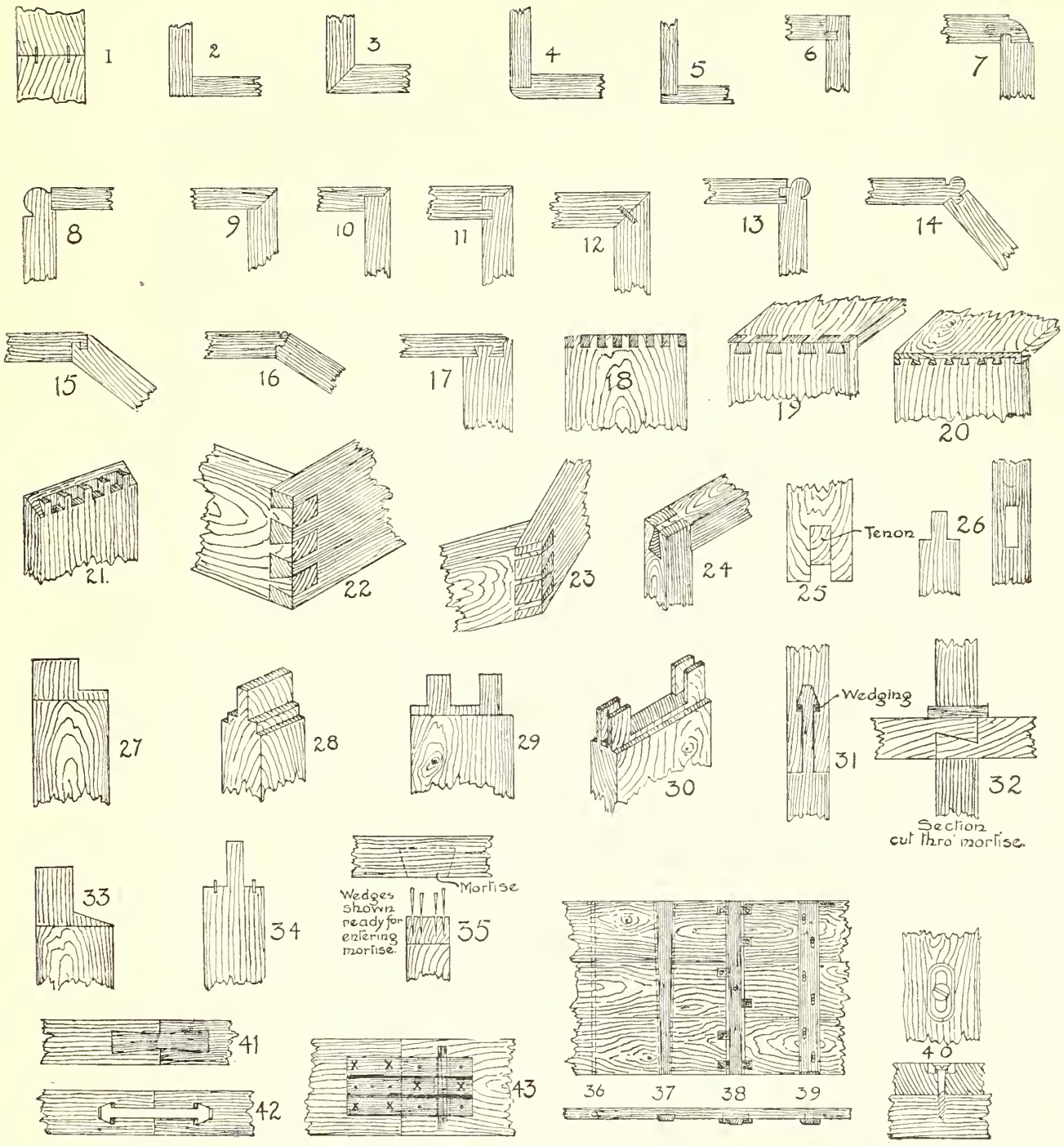

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21.
22
23
24
Tenon
26
25
27
28
29
30
Wedging
31
32
Section
cut thro' mortise.
33
34
Mortise
Wedges
shown
ready for
entering
mortise.
35
41
42
43
36
37
38
39
40

FIG. 89.

CHAPTER II

SKIRTINGS, DADOS, AND PANELLINGS

(Contributed by H. Kennard)

It is customary to fix round the walls of all rooms, halls, passages, etc., a finishing of some description, in order to cover the angle of junction between wall and floor. These finishings vary in name according to their different characters. The simplest of all forms is that of a plain fillet of wood nailed to the floor, adopted only in common class work, or in rooms used as stores and warehouses.

Boarding placed along the floor, flat against the wall, to a height of from 7 to 15 inches above the floor, is known as *Skirting*.

This may be of two kinds—*Plain* and *Built-up* or double faced.

Plain Skirting consists of a single board only, having a moulding worked on its upper face edge. Preparation has to be made for the fixing of all skirtings by means of *Grounds*. These consist of two narrow strips of wood, of the thickness required for plaster. The lower one, sometimes called a *Fillet*, is

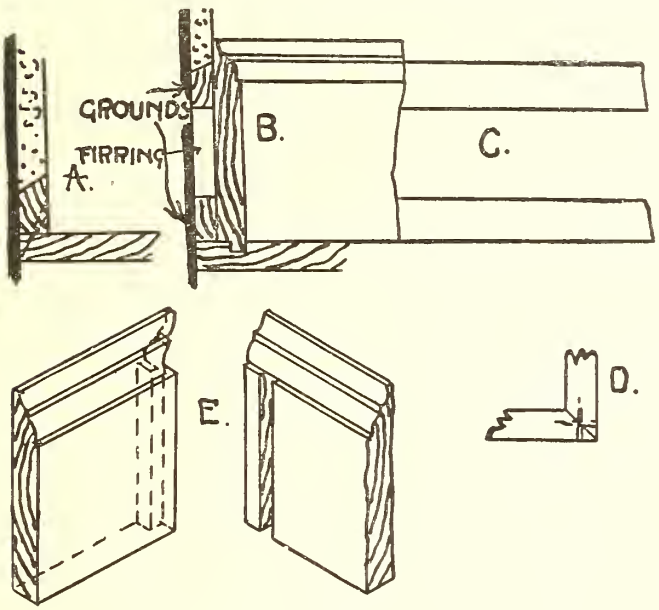


Fig. 90.

fixed along the floor; the upper one is placed so that it shall be not more than ½ an inch below the top edge of skirting. It is splayed to form a key for plaster as shown at B, Fig. 90. The top ground is fixed before the plastering is done, and acts as a screed to carry the plasterer's rule.

Short upright pieces, known as Blockings or Firrings, are also placed between the grounds, and spaced about 3 feet apart.

Wood plugs are sometimes driven into the wall in the joints of brickwork, for nailing to. The method of forming a plug is shown in Fig. 91, where

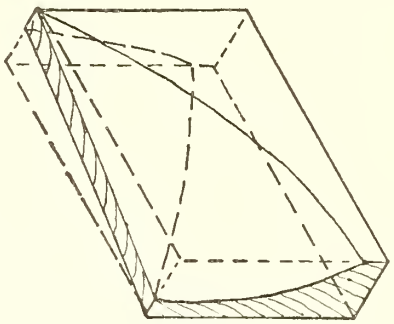


Fig. 91.

a short length of timber is taken and two opposite angles are cut off with an axe. This gives the piece of timber a wedge-shaped section, which winds throughout its length, so that when it is driven into a wall it cannot become loose by shrinkage. More commonly the case in all good class work, *Fixing Bricks* are inserted, which are bricks made from a mixture of coke breeze cement and oil. Nails or screws can be driven into them; and being made the same size as ordinary bricks, they can be bonded in with the other work. They provide the best fixing for all joiner's work.

Skirtings are frequently merely scribed to the floor, —that is, fitted close down on to it. This is bad, as in case of shrinkage a space occurs, creating a harbour for dust and vermin. The correct method of fixing is by means of a groove and tongue joint as shown at B, Fig. 90. The board should also be fixed with the heart side outwards, as in case of any tendency to cast the top edge will then bind more closely to the wall. The correct face is shown by the curve of the annular rings. The external angles of skirtings should be mitred and cross bradded as at D, or mitred and dovetailed in the case of hard wood, as explained in Fig. 89. Internal angles should have the square

portions tongued and grooved, and the mouldings scribed as shown at E.

Built-up Skirtings consist of two or more pieces tongued together, and arranged in such a manner that, while each piece is moulded separately, the whole when put together forms one continuous moulding. They are more elaborate than ordinary plain skirting, are frequently executed in hard woods, and have less tendency to warp and twist owing to their being made up of several small pieces.

Fig. 92 gives an example of a built-up skirting.

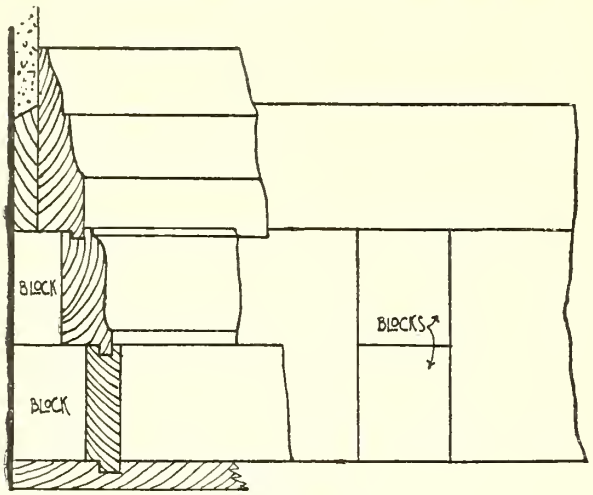


Fig. 92.

As in the case of all hard wood or polished finishings, nail or screw fixings would be most unsightly, *Secret Fixings* are generally resorted to. These either consist of screws driven into the grounds or backings with the heads left projecting from $\frac{1}{4}$ to $\frac{3}{8}$ of an inch, slots being formed in the back of the skirting to receive them as shown at A, Fig. 93, or small dovetail pieces

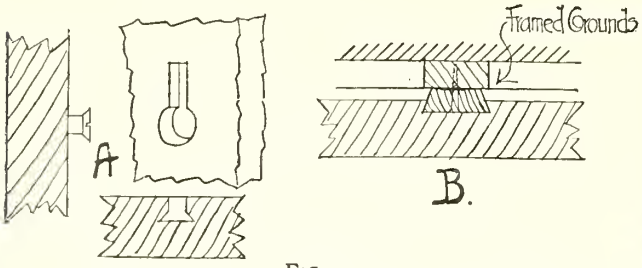


Fig. 93.

of hard wood are secured to the ground and corresponding dovetail mortises are made in the skirting, as shown at B.

When the woodwork to walls is carried up to a height of from 3 to 4 feet it is termed a *Dado*. When continued higher, say from 6 to 7 feet or the full height of room, it is generally given the name of *Wainscoting* or *Wall Framing*.

Dados admit of a great variety of treatment, the framing often being filled in with richly carved panels. They may be divided into two kinds. Those constructed of boards placed horizontally and tongued together, being known as *Horizontal Dados*; and those consisting of a framework filled in with panelling, called *Framed Dados*.

Horizontal Dados are usually constructed of stout boarding $\frac{7}{8}$ or 1 inch thick, with ploughed and tongued joints, either plain, beaded or V-grooved, dovetail keys or battens being fixed to the back to prevent casting. Where a dado is fixed the skirting is generally planted on the face of it, forming a base or plinth, the top of dado being finished with a neat moulded capping. This capping, where of sufficient width, is sometimes provided with either a small ledge or groove, so that photographs or other small articles may be safely placed thereon if desired, as shown in Fig. 94.

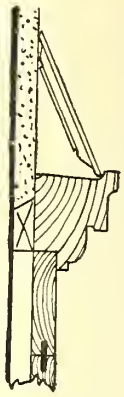


Fig. 94.

A simple and effective variation on the horizontal dado may be formed with hardwood base and skirting, having a capping to match, filled in with pitch-pine tongued, grooved, and V-jointed match-boarding in narrow widths placed vertically.

Framed Dados, as the name implies, consist of a framemork of more or less elaborate design filled in with panels, as shown in Fig. 95. The framing should

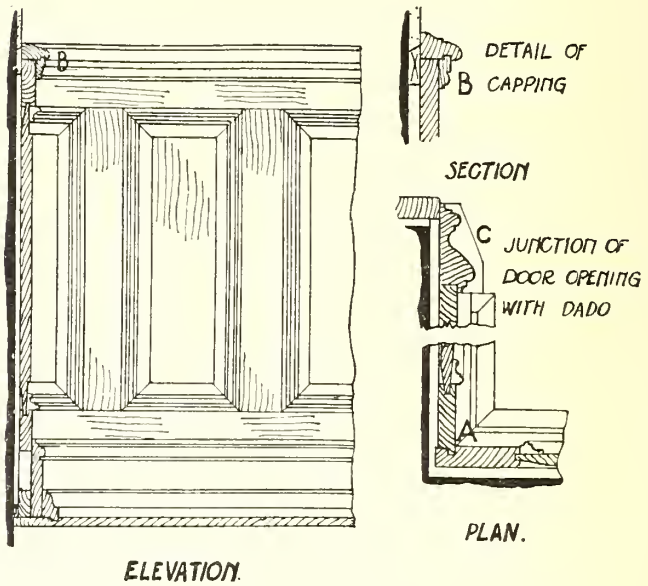


Fig. 95.

all be properly fitted together by means of mortise and tenon joints. Mouldings where possible should be worked in the solid, and mitred round panels as shown in Fig. 96. Work of this kind should always be put together and wedged up in the shop and sent out in convenient lengths for fixing. External angles in dado framing should be dovetail mitred, internal angles

tongued and grooved as at A, Fig. 95, and the capping mitred. The method of fixing the capping is shown at B, and the junction between the dado and architrave is shown at C.

Framed dados must be secured to the walls by properly framed grounds, these being constructed in

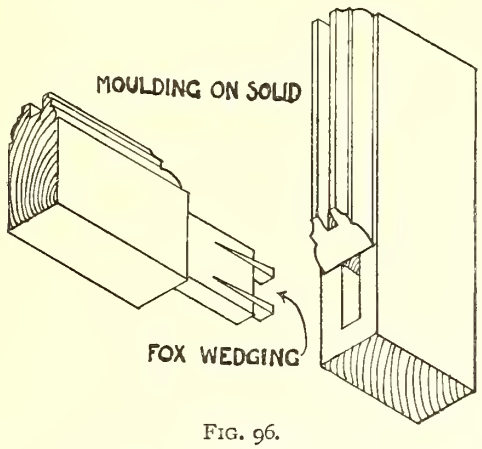


Fig. 96.

each case to suit the design of dado, and in such a manner that a backing is provided to all the principal parts of the dado framing; thus obtaining rigidity and allowing ample opportunities for the provision of secret fixings, which should be employed in all dado work. These grounds should be constructed out of not less than 1-inch stuff, and framed together by means of the mortise and tenon joint or halving joint. This latter is a useful joint for inserting extra backing pieces if required after the grounds have been framed together. It should, however, always be dovetailed, as shown in Fig. 97, and not square cut

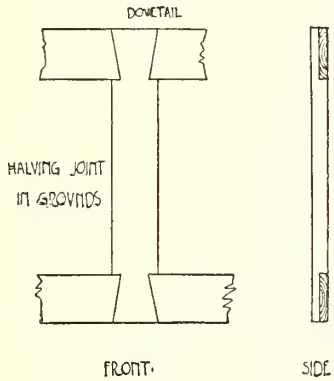


Fig. 97.

After the grounds are up it is desirable to fill into all spaces between them one or two coats of plasterer's "rough stuff." This has the effect of stopping draughts and preventing the passage of vermin at the back of dado. Care must be taken, however, that it is quite dry before the dado is fixed, otherwise the dampness will affect the joints in framing.

Wall Framing and panelling or wainscoting is the name applied when the whole or the greater part of the walls are covered. In the case of plastered ceilings it is sometimes stopped about 12 to 15 inches below the ceiling, and finished with a moulded capping which is made to serve the purpose of a picture rail.

Wall Framing is an elaboration of the principle of framed dado work, the method of construction being the same. Care must be taken that a correspondingly strong system of grounds and backings be framed for fixing to wall. These should, in the case of all hardwood framing, be provided with secret fixings. The spaces should also be filled in as mentioned for dado framing.

As an alternative to covering the walls with all wood work, the plan is sometimes adopted of having a moulded framing only, the panelling consisting of "Lincrusta Walton." This is a material made from a mixture of fibre with boiled oil and driers, rolled on to a textile material and moulded into a variety of designs by heavy machine pressure. This material is a thick pliable substance, turned out in rolls like wall paper, and is fastened to the walls with a thick mixture of paste and glue, in the respective proportions of about two to one. It forms an excellent and effective substitute for panelling. The surface is hard, and has the great recommendation that it will stand washing. Dados are not infrequently constructed of this entirely, the skirting and capping only being of wood. Other materials, however, are frequently substituted for it, considerable latitude being possible. Where it forms the panelling to wood framing, the framing must be arranged to fit flat against the wall and be secured to fixing bricks, no grounds being necessary. Only a very shallow rebate should be cut in the moulding, as shown in Fig. 98, the depth being slightly less than the

Fig. 98.

thickness of the Lincrusta; this causes it to bind tightly down when fixed. The raised pattern of Lincrusta where it comes into the rebate should be carefully cut off.

In rooms where there is no dado, or only a low one, and the skirting of slight projection, a moulding is sometimes fixed round the walls at the height of a chair back, usually from 2 feet 9 inches to 3 feet known as a *Chair Rail*. Its object is to prevent the wall being damaged by having chairs pushed against it. As in the case of dado capping, it is sometimes formed so that small articles may be placed upon it.

Picture Rail is the name given to a moulding fixed round the walls of a room just below the cornice, or in cases where there is a frieze it is fixed at the bottom of this. It is moulded in such a way that its top member projects sufficiently to carry a picture hook. A rail of

this kind is shown at A, Fig. 99. Another pattern of picture rail is one having small hooks screwed to its

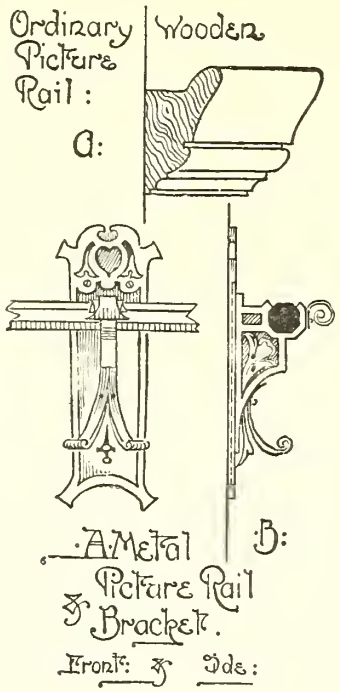


Fig. 99.

face. These support a brass rail upon which the picture hooks are hung—as shown at B, Fig. 99. Picture rails are sometimes made as shown in Fig. 100, so that wires for electric lights or bells may be

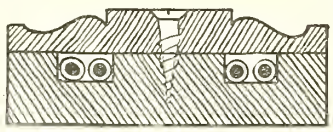


Fig. 100.

carried within them. Provision for fixing picture and chair rails should be made when the walls are built by the insertion of fixing bricks in the proper positions, and at frequent intervals. It is advisable to keep a record of these positions, as otherwise great difficulty may be experienced in locating them after the walls are finished, especially in the case of plastered walls.

Frieze is the name given to that portion of the wall which occurs immediately below the cornice, down to the picture rail or capping of framing. When made entirely of wood, friezes are not as a rule framed, but usually consist of boarding laid horizontally and fixed by means of a groove and tongue joint to the picture rail along the lower edge, and by a similar joint at the top to the bottom member of the cornice.

When a frieze exceeds 9 inches in width it is advisable that it be made up of two or more pieces grooved and tongued together, and dovetail keyed at back to prevent casting, as friezes are generally richly carved or decorated. Upright wood backings are provided for securing to wall, and should be placed not more than 3 feet apart. It is seldom that a frieze is of sufficient width to necessitate framed grounds.

Wood Cornices are as a rule only used when the ceiling is covered with wood. The correct method of forming a wood cornice is to build it up of rectangular pieces of wood grooved and tongued together, and arranged in such a manner, according to the design of the cornice, that the various mouldings may be worked on the salient angles. By this method cornices of almost any projection can be formed, the various lengths of the same members being butted, dowelled and glued together and arranged so as to break-joint with the adjoining lengths. Fig. 101 gives a simple illustration of a built-up cornice.

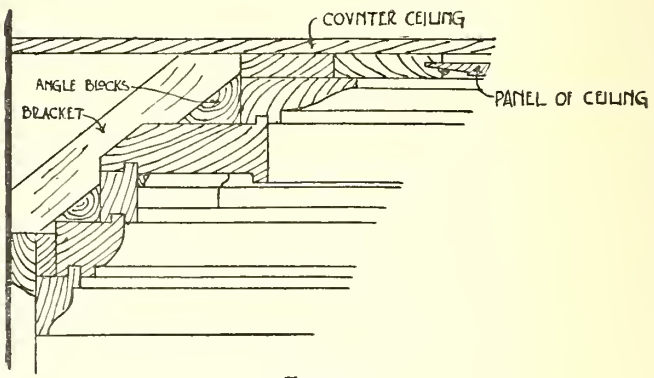


Fig. 101.

Great care is necessary in cutting the mitres of a built-up cornice in order to obtain a well-fitting joint throughout the entire depth. It must be placed in the mitre box for cutting, at the exact angle it will occupy when fixed. All angles of built-up cornices should be mitred and dowelled.

As it is frequently found necessary in practice where there is much moulded work to either enlarge or diminish the size of a moulding while strictly maintaining the form of each member and its proportion to the whole, the simplest methods of accomplishment are here given.

To enlarge a moulding, produce a series of parallel lines from each member as shown in Fig. 102. Assuming the vertical depth × to be 6 inches and the required depth of enlarged moulding 8 inches, take any point A on one of the outside lines, and where the distance of 8 inches cuts the other outside line mark point B. Join these two points, and draw lines at right angles to AB from each point of its intersection with the lines of the original moulding. These lines will give the members of the required moulding, the proper projection being found by measuring the angle shown by the dotted lines and making the angle ABC equal thereto.

The diminishing of a moulding is based upon the principle that if a line be divided into any number of

parts and each part joined to a common point, lines through which they may pass, and which are parallel

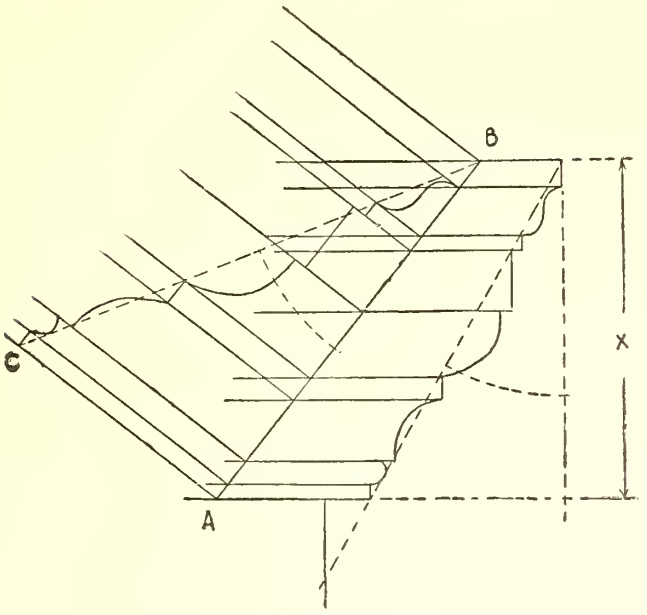


Fig. 102.

to the original line, are proportionately divided. Fig. 102A illustrates this, where the line CD is divided into five parts equal in proportion to the parts of the line AB.

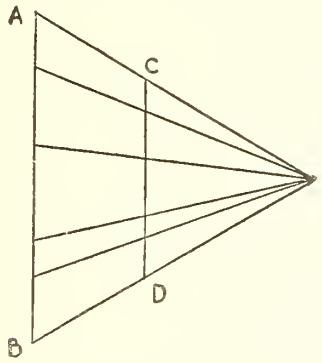


Fig. 102A.

For simplicity of illustration we will take the same moulding as Fig. 102, and show the method of diminishing in Fig. 103 to 4 inches. Draw AB vertically, and produce lines from each member to cut it. Join the extremities of AB to a common point O, and then draw CD between these lines, exactly 4 inches long, and parallel to AB. Lines drawn from the divisions of AB to O will intersect CD at the required points, and lines at right angles to CD from these points will give the members of the new moulding, the projection being found as in the case of enlargement.

Raking Mouldings. — When raking mouldings are mitred with horizontal mouldings, the sections of the former must be altered, otherwise they will not fit the latter. The method of finding the section of the raking moulding from the section of the horizontal moulding is shown in Fig. 104. A number of convenient points are taken on the outline of the horizontal section,

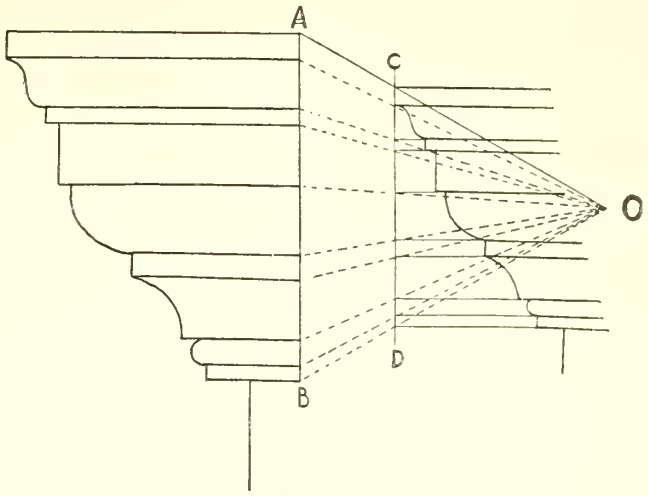


Fig. 103.

and from these points parallel lines are drawn at the inclination of the raking course. A line is drawn at right angles across these inclined lines, and from it the

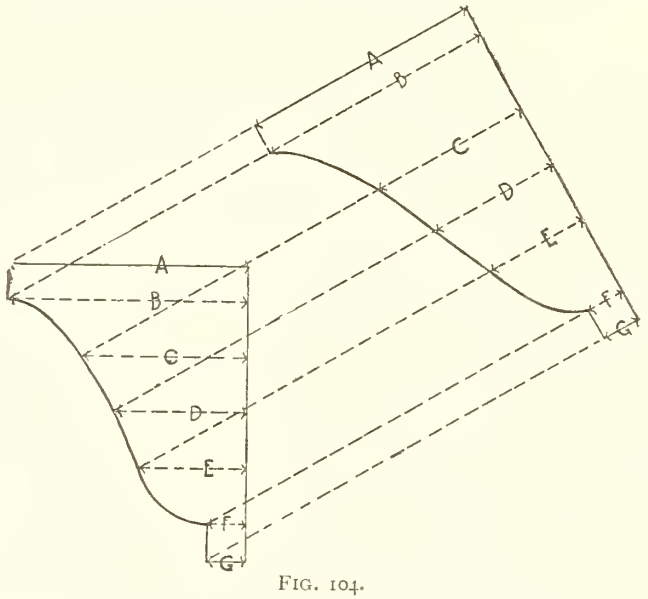


Fig. 104.

distances A, B, C, D, E, F, and G are set out corresponding respectively in length to the distances similarly figured upon the section of horizontal moulding.

Ceilings. — Covering ceilings with wood may be accomplished in two or three ways. The simplest form is that of nailing match-boarding to the under side of joists, having the joints running either parallel to the length of the room or diagonally; or it may be arranged to pattern, having a moulding planted on the face to simulate framing. This moulding must be arranged so as to cover all the heading joints in boarding. By this method a fair representation of a panelled ceiling may be produced, as shown in Fig. 105.

Another method is that of fixing up ordinary framing and panelling, constructed in the same manner as wall framing. This is also fixed directly to the joists, a good plan of fixing being shown in Fig. 106, where the framing is screwed to the joists, a small cover mould being planted on afterwards to hide the screws. The

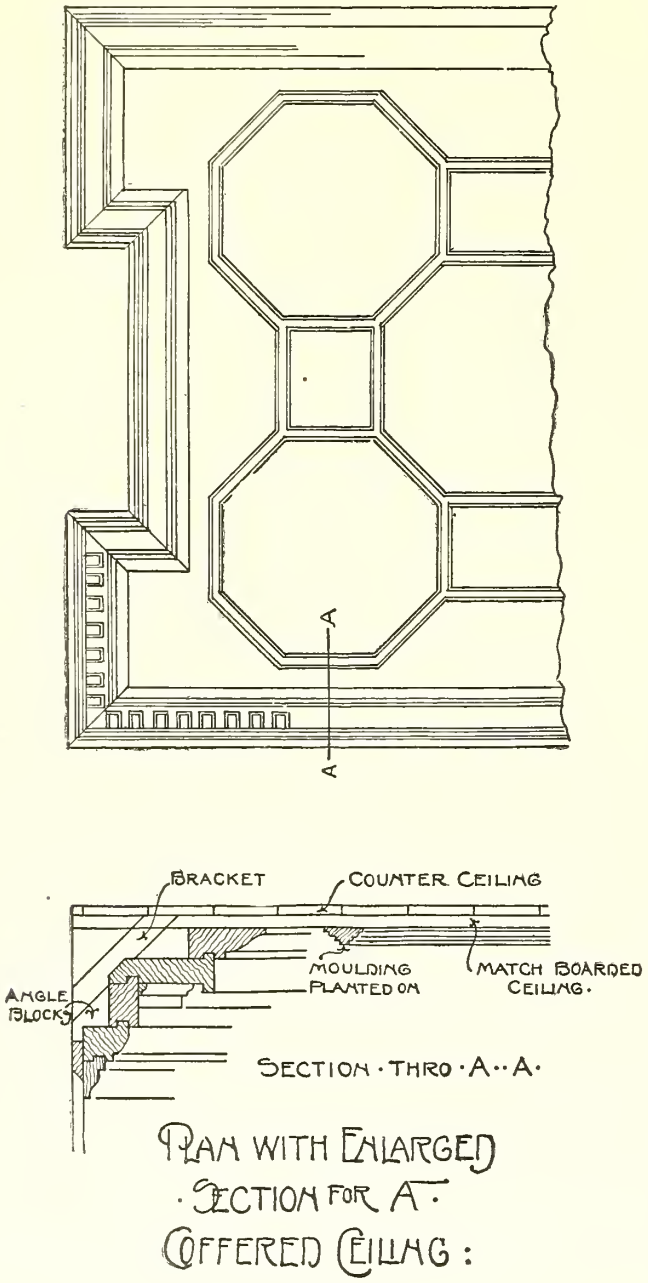

BRACKET
COUNTER CEILING
MOULDING PLANTED ON
MATCH BOARDED CEILING.
ANGLE BLOCK
SECTION · THRO · A·· A·
PLAN WITH ENLARGED · SECTION FOR A · COFFERED CEILING :

Fig. 105.

same Figure shows the method of casing an iron girder, wood bearers being fixed at convenient intervals to form an attachment for the framing.

The panels should not be fitted tightly into the grooves in framing, but should be given room to shrink or swell without splitting. They should be arranged in a convenient size, in order to avoid jointing as much as possible. Where jointed, they must be grooved, tongued, and glued, and have keys fixed across the grain at the back by means of screws in brass slots. It is much better, however, to have a number of small panels in a ceiling than a few large ones, as this part of a room is subjected to a more varying temperature than any other, and the great heat which plays upon it after fires and lights have been burning for some time should always be taken into account when arranging its various parts, so that shrinkage may as much as possible be obviated. The wood should be carefully selected, any having the slighest defect or a suspicion of sap being rigidly eschewed.

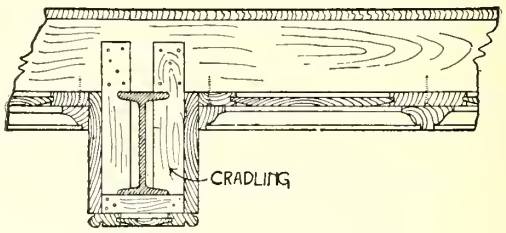


Fig. 106.

Where recesses occur in a room and the character of the design will not admit of their being included, they are generally lowered sufficiently to allow the cornice to pass them in an unbroken line, and are finished with either an arched or flat soffit.

Chimney-piece.—For the construction of a *Wood Chimney-piece* only a few specific directions can be given, as no two designs are quite alike, and each has to be treated according to the exigencies of the case. The usual method adopted is to make a framed backing or foundation to the size of the opening, and of such a form that the various mouldings and members can be securely planted thereon. 1 or $1\frac{1}{4}$-inch stuff is generally used for the frame, although sometimes thicker may be employed, and mouldings are worked in the solid. All mouldings planted on should be fixed from the back and mitred round all brakes, and it is advisable that all mitres in large mouldings be either tongued or dowelled. No wood should be allowed to come close to the ironwork of grate, but should be separated from it by tiles or brickwork, or at least by asbestos sheeting, in order to reduce the risk of fire.

Cracks in the woodwork and open joints are frequently seen in wood chimney-pieces, but this is not always due to faulty construction; for while it is essential that only the best quality wood be used, and put together by a skilled workman, it is nevertheless easy for both material and workmanship to be ruined by incompetent fixing.

A wood mantel should on no account be fixed in a new building until the walls and plaster to which it is to be attached are thoroughly dry. If fixed earlier,

when a fire is lighted the hot moisture collecting at the back of the woodwork is calculated to ruin the best possible specimen of joinery.

The additional precaution should in all cases be taken of painting the back of the woodwork prior to fixing.

An example of a wooden mantelpiece overmantel is shown in Fig. 107.

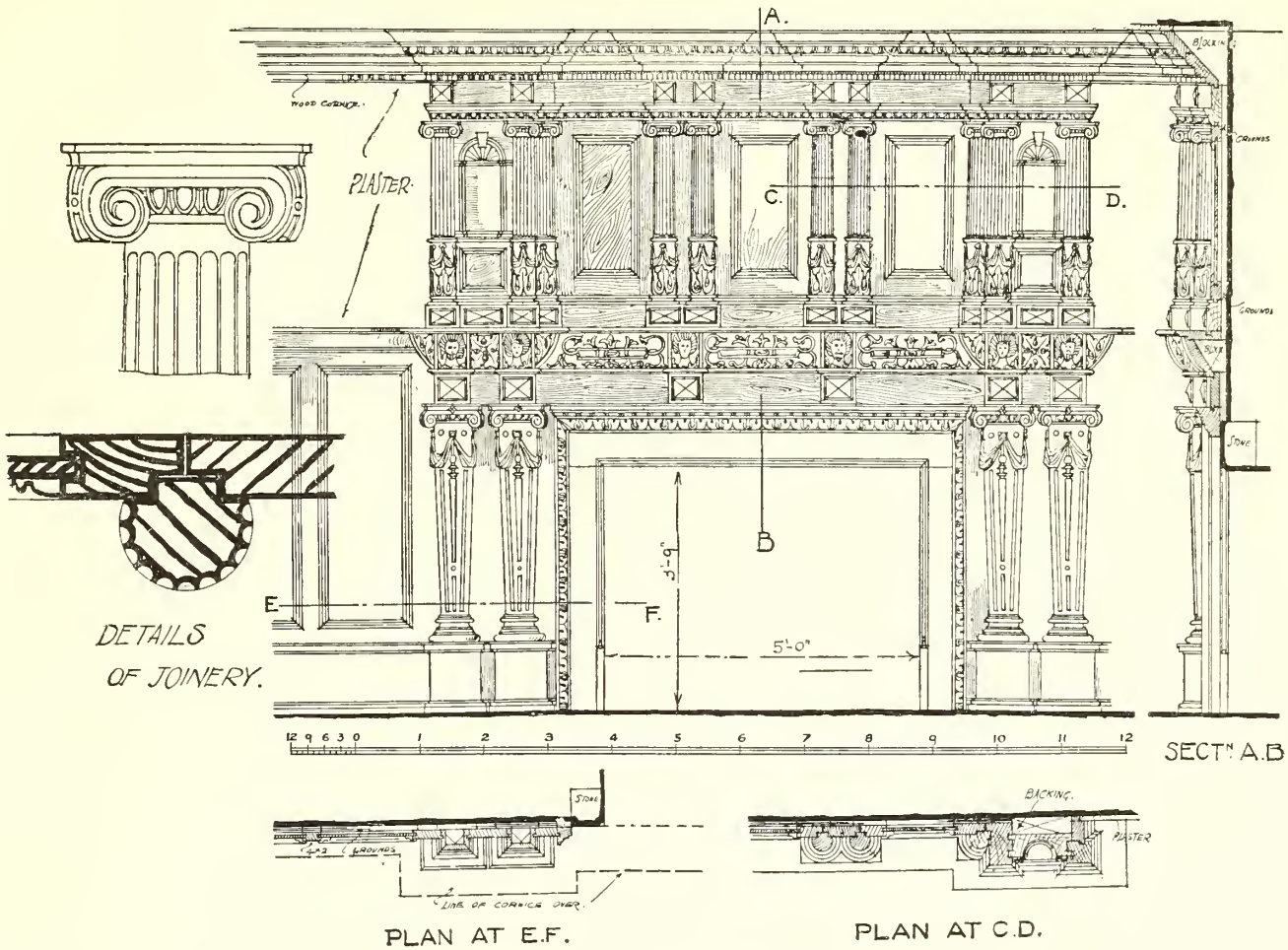


FIG. 107.

CHAPTER III

DOORS AND FRAMINGS

(*Contributed by H. Kennard*)

Doors are made in a variety of forms, and are classed under various heads, according mainly to their method of construction. Custom has, however, fixed upon certain doors, names indicative of either their use, position, or manner of hanging.

Doors are in most cases hung upon hinges or butts, and it is necessary to provide some substantial fixture for attaching the hinges to. It must be rigid, as, if not, the continual swinging and frequent slamming of the door will loosen it.

Door Frames.—External doors are always hung in what are known as "*Solid*" *Frames*. This means that the frame is composed of pieces of large section, such as $4\frac{1}{2}$ by 4 inches, and the term is used to distinguish between such frames and *Casings* or *Linings*, which are generally used for the hanging of internal doors. A solid frame usually consists merely of two *Side Posts* and a *Head*, the entrance step of doorway forming the sill. The posts are also sometimes called *Jambs*, although the term is more generally applied to the sides of linings. The posts are framed into the head with mortise and tenon joints, as shown at A, Fig. 108, and the ends of the head are left projecting about $4\frac{1}{2}$ inches beyond the posts, so as to be built into the walls. These ends are known as "Horns." When the posts rest on a stone or concrete step, which is usually the case, iron or slate pegs or "dowels" about 3 inches long are let into post and step. A better plan, however, and one which preserves the posts, is to fit cast-

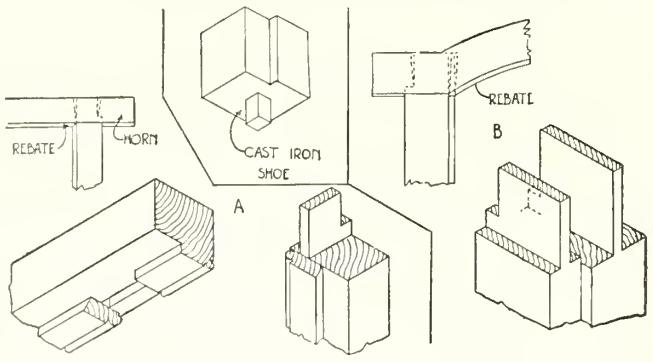


Fig. 108.

iron shoes, as shown at C, Fig. 108, on the ends. These are provided with a dowel to let into the steps. They may be had in any size, and moulded to suit the frames.

Doorheads are sometimes made segmental, in which case, if the rise is slight, they are cut from a solid plank to the required sweep. If the curve is quick the head must be built up of two or more portions connected by means of hand-rail bolts. The posts are connected to a segmental head in precisely the same manner as with flat heads. When the posts and head of flat or segmental headed openings are greater than 5 inches in width, a second tenon is employed, as shown at B, Fig. 108.

Semicircular doorheads are usually built up in two sections, one composed of two pieces and the other of three pieces cut to breakjoint, and screwed and

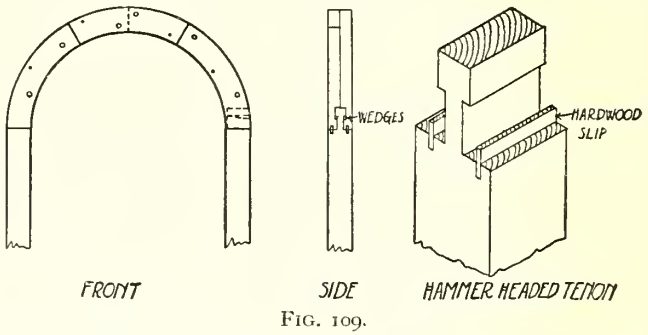


Fig. 109.

glued together as shown in Fig. 109. The posts are connected to the head by means of a hammer-headed tenon joint, as shown in the Figure.

When frames are built in it is advisable to leave a

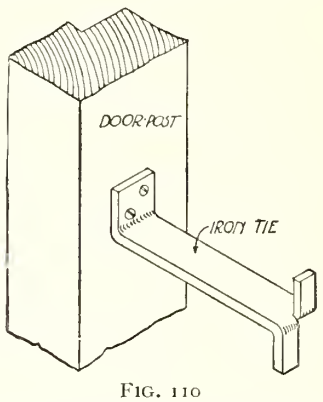
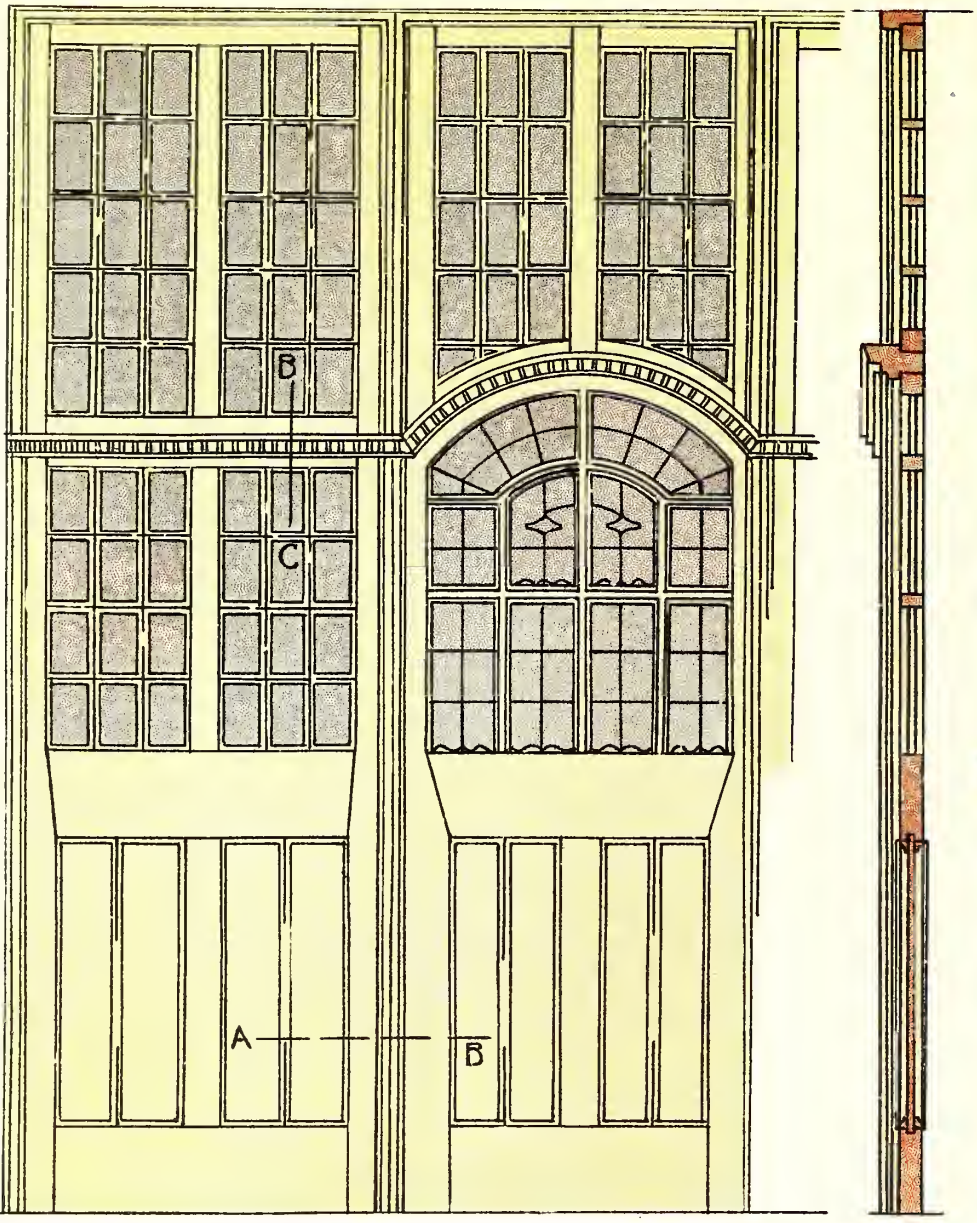


Fig. 110

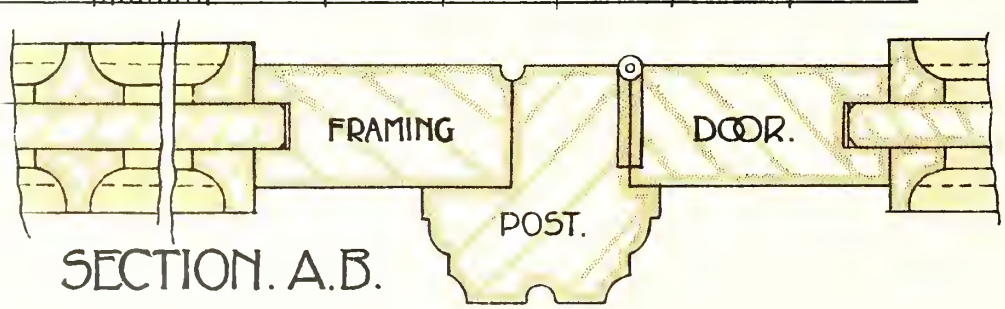
small air space between the back of the frame and the wall, otherwise there is the risk of dry rot being set up.

JOINERS DETAILS OF DOOR AND

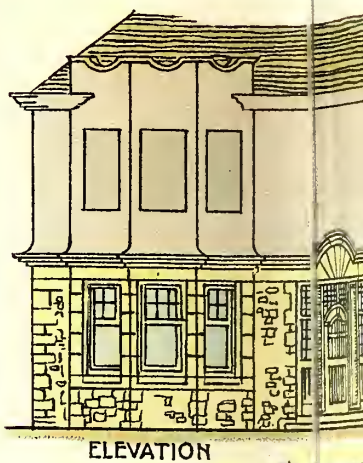


ELEVATION. SECTION.

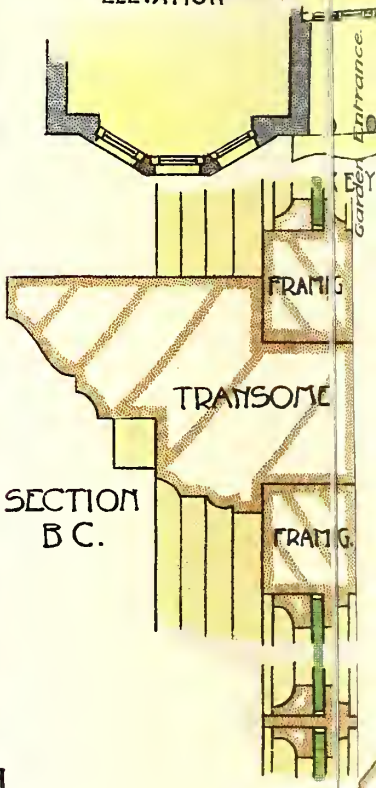
PLAN.



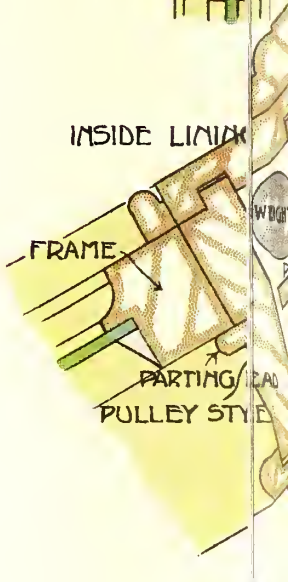
SECTION. A.B.



ELEVATION

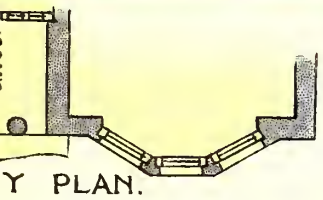


SECTION
B C.

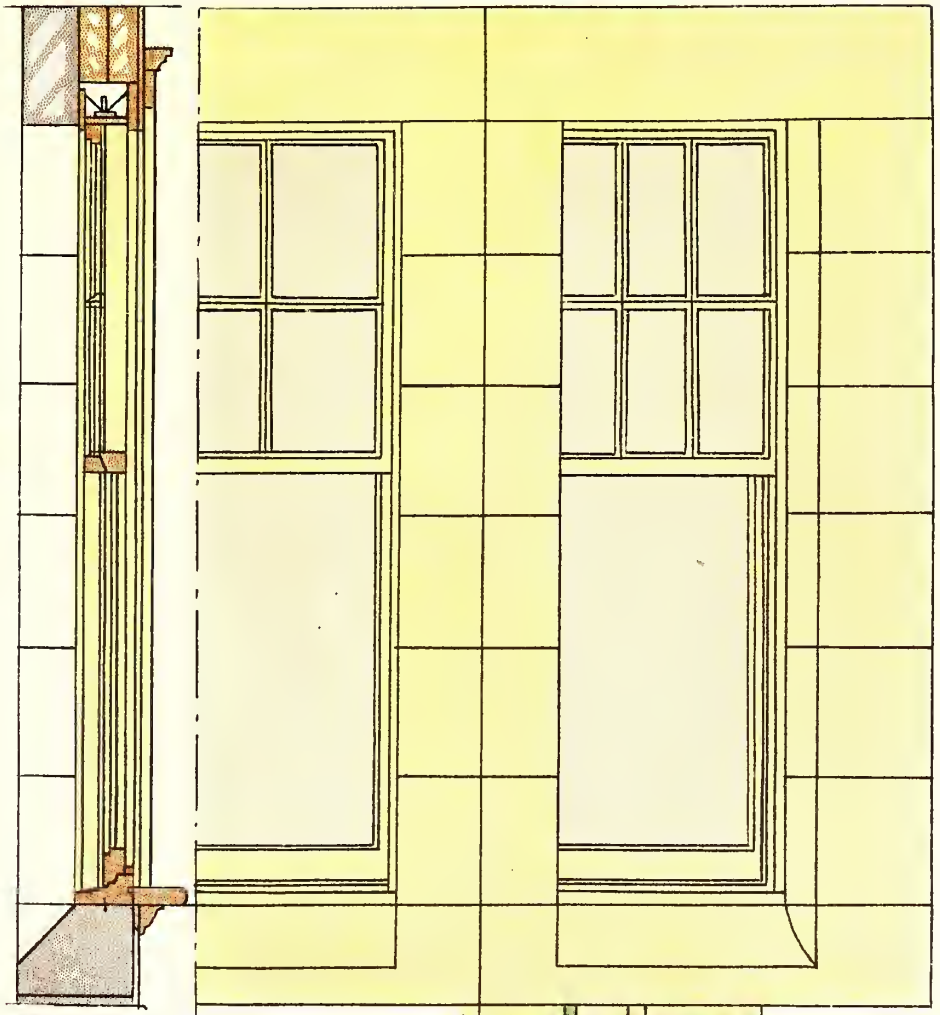


WINDOW

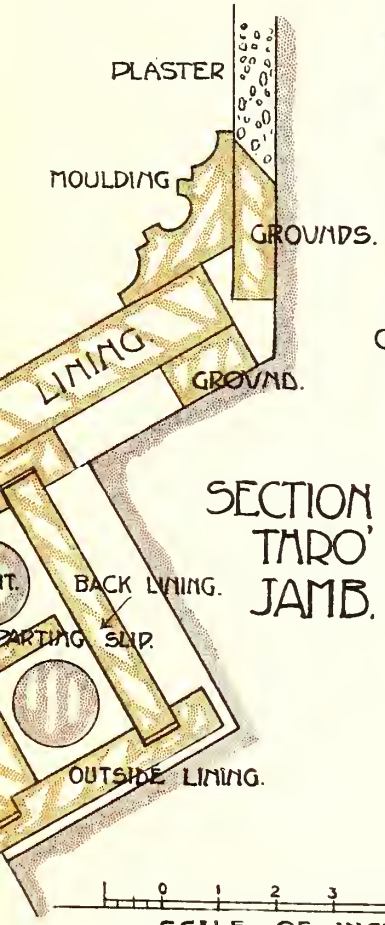
PLATE IV



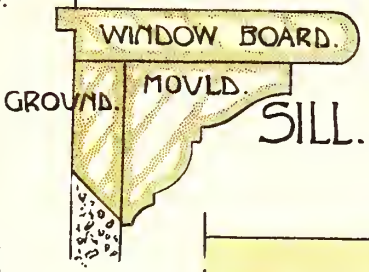
Y PLAN.



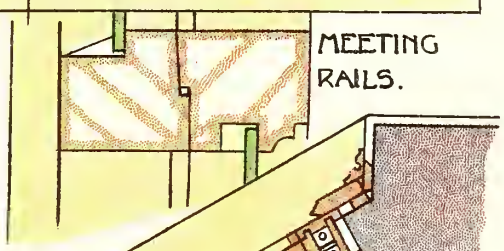
SECTION

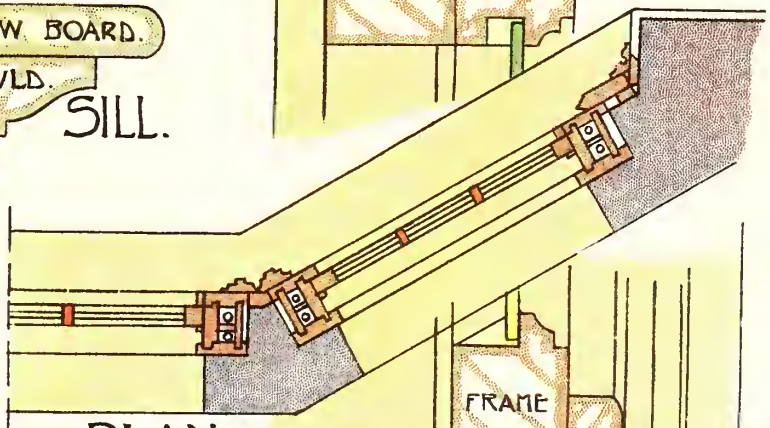


SECTION TARO' JAMB.

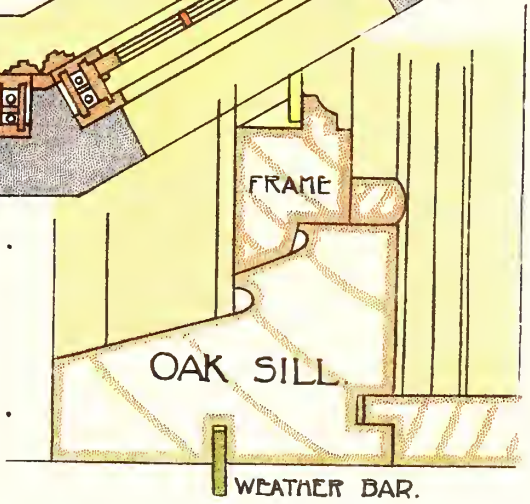


SILL.

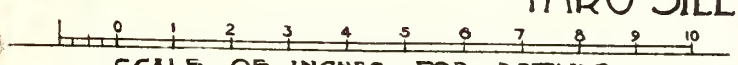




PLAN.



SECTION TARO' SILL.



SCALE OF INCHES FOR DETAILS.

Two tie irons should also be fixed to each post. These are pieces of flat iron, one end turned up at right angles and screwed to the post, the other end split and built into wall (see Fig. 110).

Door Linings.—Internal doors which occur in such positions as vestibules are also generally hung in solid frames, the framing being carried out to the walls and ceiling and filled in with panels or glass, as shown in Plate IV. The linings for internal doors are of several kinds. A "Set of Jamb Linings" consists of two sides or "Jambs" and a head or soffit lining.

"Plain" Linings consist of a single board in width. The rebate and stop for the door are formed by nailing a narrower board on the face of the lining, as shown

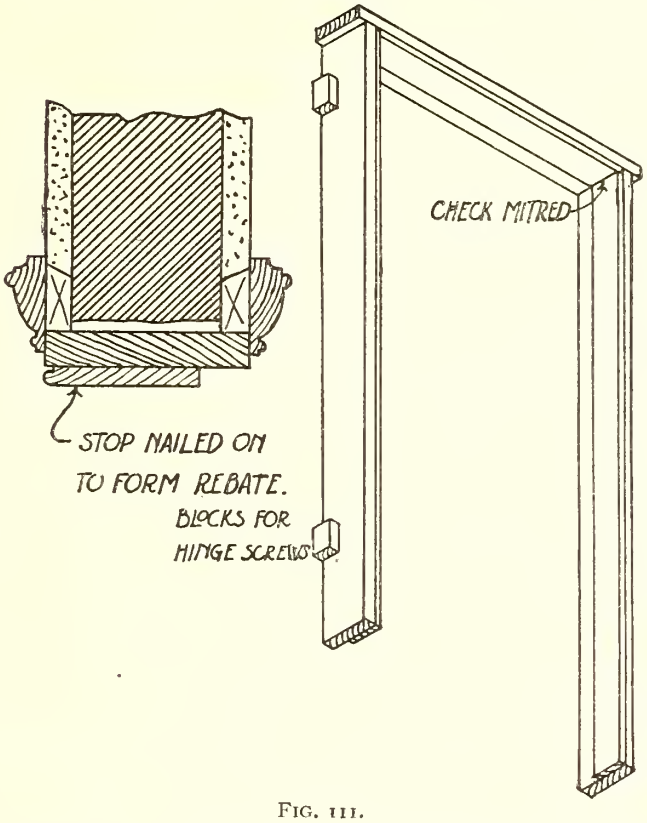


Fig. 111.

in Fig. 111. The soffit lining is usually simply nailed across the heads of the jamb linings, and the checks are mitred at the angles as shown in the isometric view. This method is only adopted in common work, however, the proper way being to form the rebate out of the solid, the jambs being got out of stuff sufficiently thick to allow of this being done, while at the same time leaving ample thickness to carry the screws for the hinges, as shown in Figs. 111 and 112. A plan sometimes adopted is that of gluing small blocks of wood to the back of the jambs just where the door hinges will come, as in Fig. 111, so that the screws may be driven through the lining into them. When the linings are rebated on both edges, as in Fig. 112, they are termed "Double rebated." The joint between the soffit lining and jamb lining of double-rebated linings is formed by a groove-and-tongued joint. For

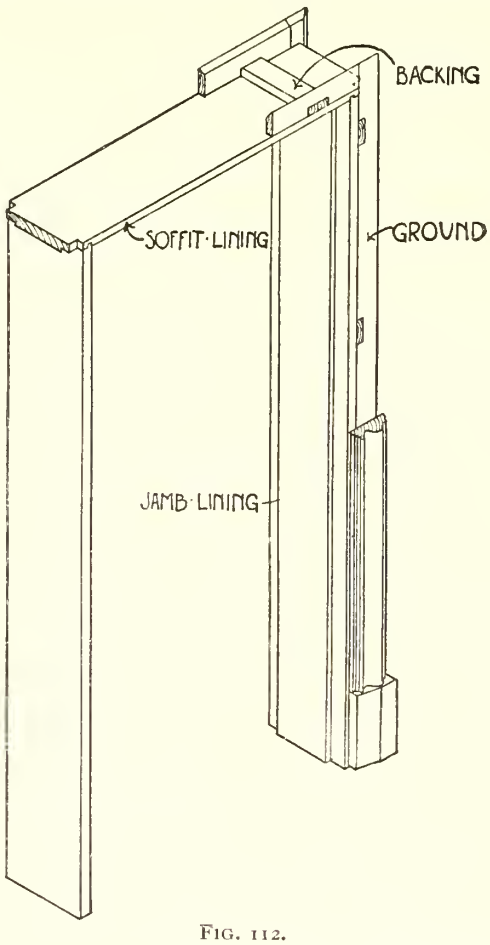


Fig. 112.

all walls of 14 inches thick and over, linings should always be "Framed." These may be of two kinds—"Framed" and "Double Framed."

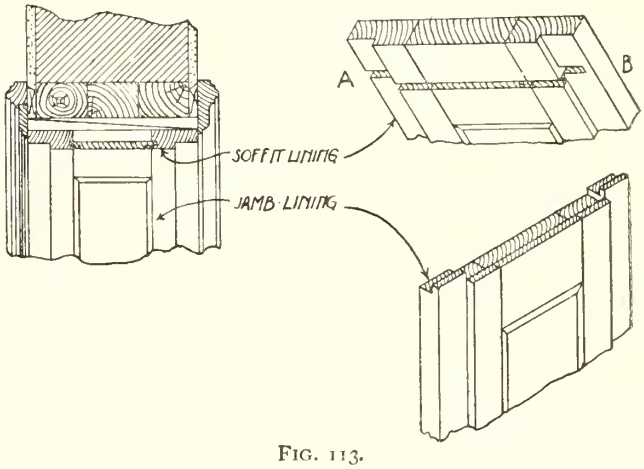


Fig. 113.

Framed Linings.—In framed linings the jambs and soffit are constructed of styles and rails, framed together with mortise and tenon joints and filled in with panelling, as shown in Fig. 113. The rebates

are formed in the solid on the styles, and the tenons should be "stub." They are fixed together by means of a groove-and-tongue joint, the tongue being cut right across the top end of the jamb and housed into a groove in the soffit. When the work is to be painted the groove is carried right across the rebate, as at A, Fig. 113.

Double-Framed Linings.—In double-framed linings the styles are made up of two pieces, double grooved

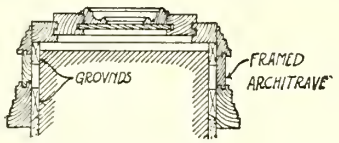


Fig. 114.

and tongued, so that the inner piece projects to form rebate and stop. The outer piece is of thicker stuff, and is fixed securely round the opening, so that it will carry doors of any weight, and the inner framing is grooved to it with dry joints, fitted "hand tight," so that in case of any expansion or contraction the inner framing is free to move without in any way affecting

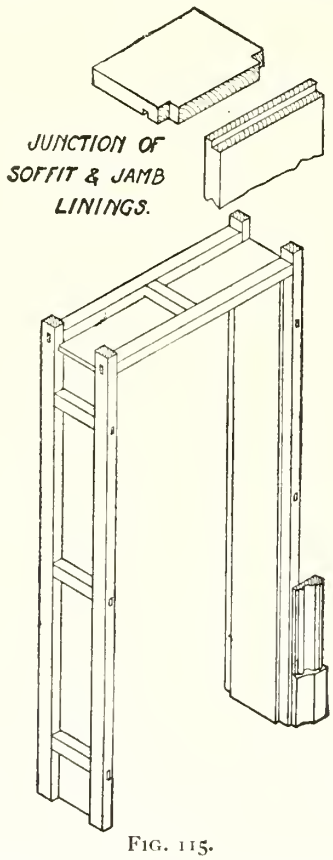


Fig. 115.

the outer pieces. The backs of all framed linings should be painted before fixing, as it preserves the woodwork from damp. This form of lining, together with the junction between the soffit and jamb, is shown in Fig. 114.

Skeleton Jamb Linings.—Another kind is known as "Skeleton Jamb Linings," in which a skeleton framework is formed, and a single board, forming the stop, is nailed on the face as shown in Fig. 115. This should only be used for narrow walls, as the stop is liable to shrink and split.

"Grounds" are required to all door openings in plastered walls, in order to provide a foundation and fixing for linings and architraves, as shown in Figs. 111, 112, 113, and 114. They are either slightly bevelled at the back, as in the case of skirting grounds, or may have a groove run in them to provide a key for the plaster. In thickness they are generally made out of 1-inch stuff, and their width is governed by the depth of the

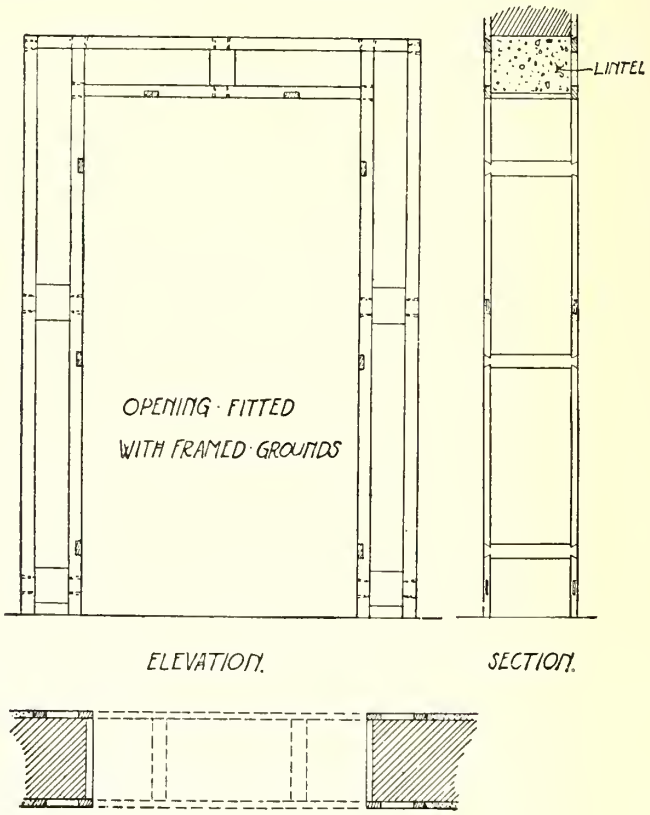


Fig. 116.

architrave. In cases where this would necessitate the width of grounds being more than from 4 to 5 inches they should be made up of a skeleton framework as in Fig. 116, consisting of styles and rails, and the width should be such that the architrave will not be more than $\frac{3}{8}$ of an inch beyond the outside edge. They are nailed to plugs or fixing bricks in the wall, and should project 1 inch beyond the brickwork in the opening, and be connected across the face of the brickwork by 1-inch "backing pieces," about 2 inches wide, dovetailed to the edge of the grounds. They are sometimes fixed flush with the brickwork, but this is bad construction, as it either necessitates the use of folding wedges and "firrings" when fixing

the linings (and these do not supply a satisfactory background), or the linings have to be fixed tight against the wall, which is worse still.

Finishings are provided to door openings in the form of "Architraves." These consist of a moulding,

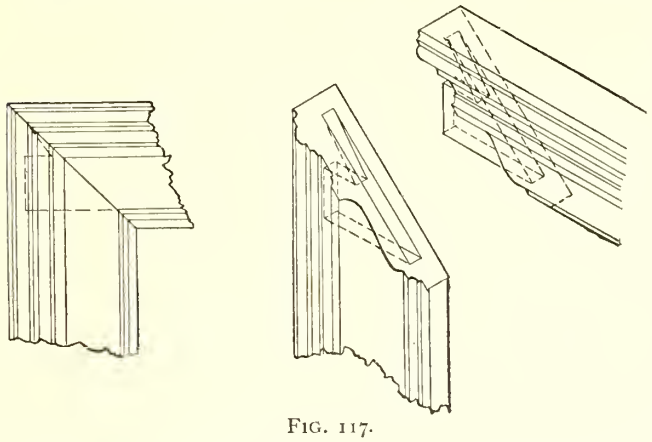


Fig. 117.

fixed to each side and across the head, being mitred at the angles. They may be of various sizes and designs, and are either "single faced" or "double faced," and may consist of one piece or be built up of two or more pieces, in which case they are called "Framed" Architraves.

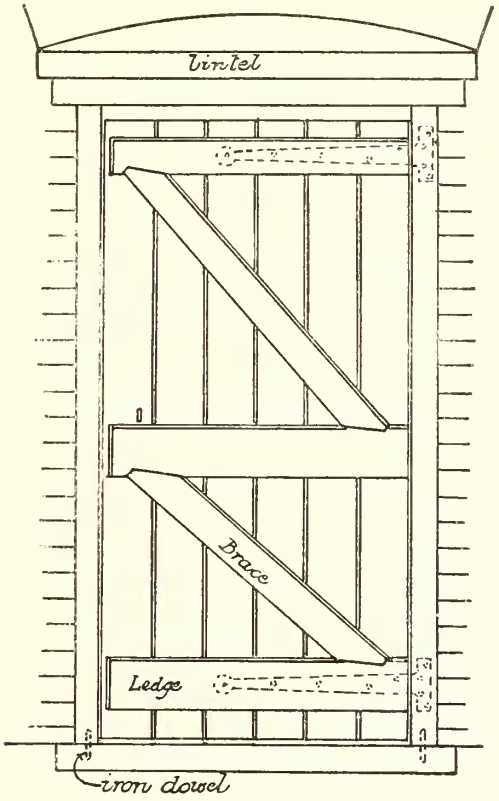


Fig. 118.

Single-Faced Architraves.—A maximum width of from $5\frac{1}{2}$ to 6 inches should be observed for architraves of one piece. If wider than this they should be framed to prevent any liability to shrink and warp. Small architraves may have plain mitres at the angles, but in the case of wide, heavy architraves the mitres should be grooved and cross-tongued, or they may be stub mortised and tenoned as shown in Fig. 117. "Plinth blocks" should be fixed to the feet of all architraves. These consist of small plain blocks forming a base to the whole, and fixed by either of the methods shown in Fig. 121 to the architraves.

Doors.—The common doors, such as are used for

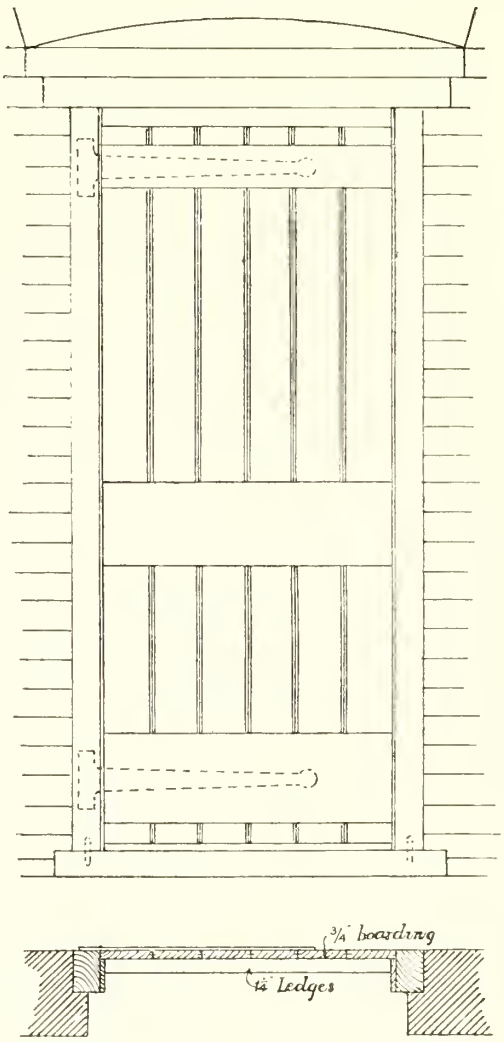


Fig. 119.

outside domestic offices and yard buildings, are usually of the kind known as *Ledged and Braced* or *Ledged, Framed and Braced.*

Ledged and Braced Door.—These are made of battens of any thickness from $\frac{3}{4}$ to $1\frac{1}{4}$ inch, according to the size and strength of door required. They are grooved and tongued together, match-boarding being frequently used, and have three "ledges" screwed or nailed across, as shown in Fig. 118. "Braces" are fixed across as shown, and are notched into the ledges at both ends. The braces and ledges should be

slightly bevelled along the upper edge to throw off wet.

These doors must always have both braces fixed with the lower ends towards the hanging post to prevent "racking," or twisting of the door will otherwise result.

"Ledged" Doors are sometimes made as shown in Fig. 119. They are similar to the foregoing, but *without* braces, and are not satisfactory, for unless they are very narrow they are sure to twist.

opposite the ledges, if on the other side they should be screwed to the ledges. Framed and braced doors may be hung either with these or with butts. Rim locks or bolts are used as fastenings, while the latch is generally of the "Norfolk" or "Suffolk" pattern, with bow handle and thumb lever. A recent improvement in these latches abolishes the objectionable hook on the reverse side, and substitutes a second bow, thus having a bow and thumb lever on each side of the door.

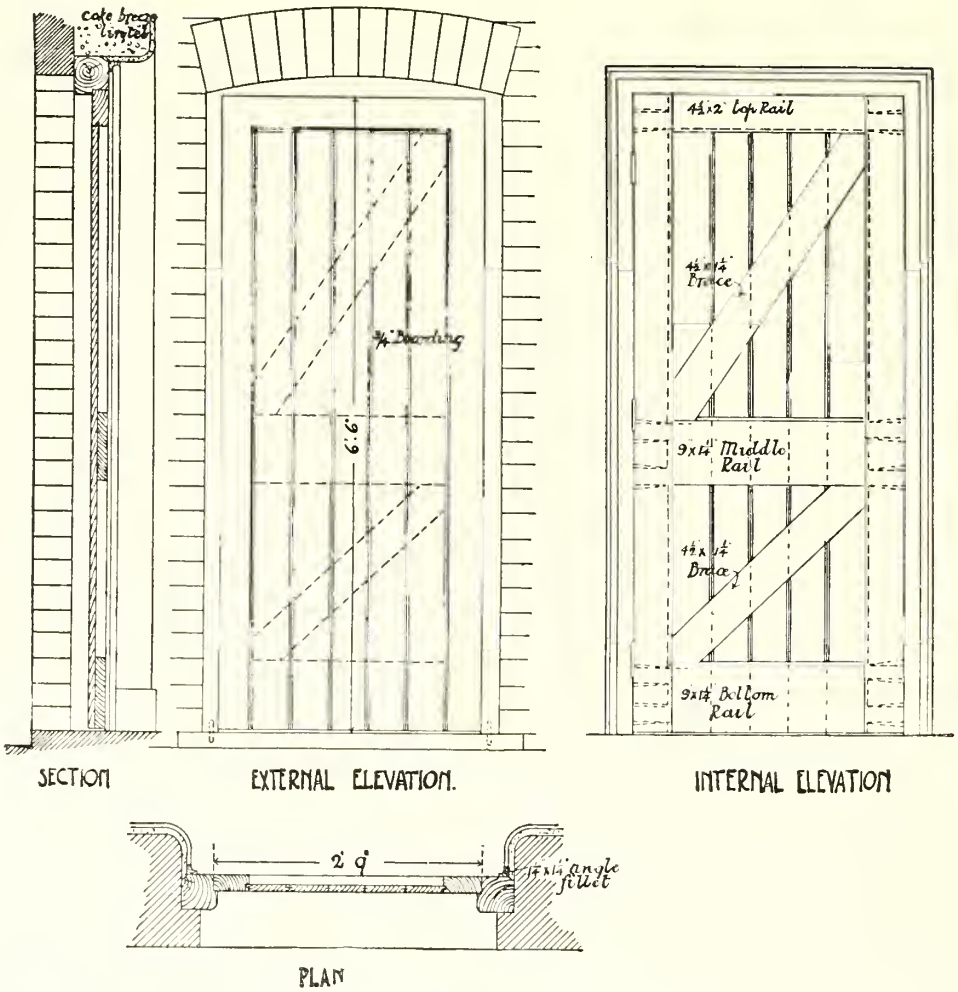


Fig. 120.

Ledged, Framed and Braced Doors, illustrated in Fig. 120, are similar to ledged and braced, but with the addition of a framework on three sides consisting of two styles and a top rail. The thickness of framing is equal to that of the ledges and battens combined. The battens are tongued into the styles and head, and the ledges are bareface tenoned into the styles. All joints in these doors should be put together with white lead or thick paint.

Ledged and braced doors are hung in nearly all cases on "Cross garnet" or "Tee" hinges, shown in Fig. 118. If fixed to the face of the door they should come

Framed and Panelled Doors.—In descriptions of framed and panelled doors it is usual to first state the number of panels and then specify their kind, how moulded, etc. Panels fixed with the grain running vertically are called "Standing," and those with the grain running horizontally "Lying" panels.

The simplest form of this kind is the four-panel square sunk door. This means a door having a framework consisting of two styles, top, bottom, and middle or lock-rails and two muntings, all with square edges and filled in with four plain panels. Fig. 121 shows a four-panel door in elevation, plan, and section.

Fig. 122 shows the same door with the various stages of putting together, which will apply, with slight variations, to most kinds of doors. The top munting is stub-tenoned into the top and middle rails, and the bottom munting into the middle and bottom rails; the rails are tenoned into the styles (see Fig. 123), the top rail with one, and the bottom and middle usually with two single tenons each. When a mortise lock is to be fitted to a door double tenons are used for these would be fox-tenoned,—the panels are then inserted, and the styles knocked on and wedged, glue being used to all mortise and tenon joints. In the case of polished hard-work doors the rails should always be fox-tenoned so as to avoid disfiguring the outer edges of styles by having the ends of tenons showing.

Fig. 124 shows a six-panel door of an ornamental character. The posts are connected to the head by

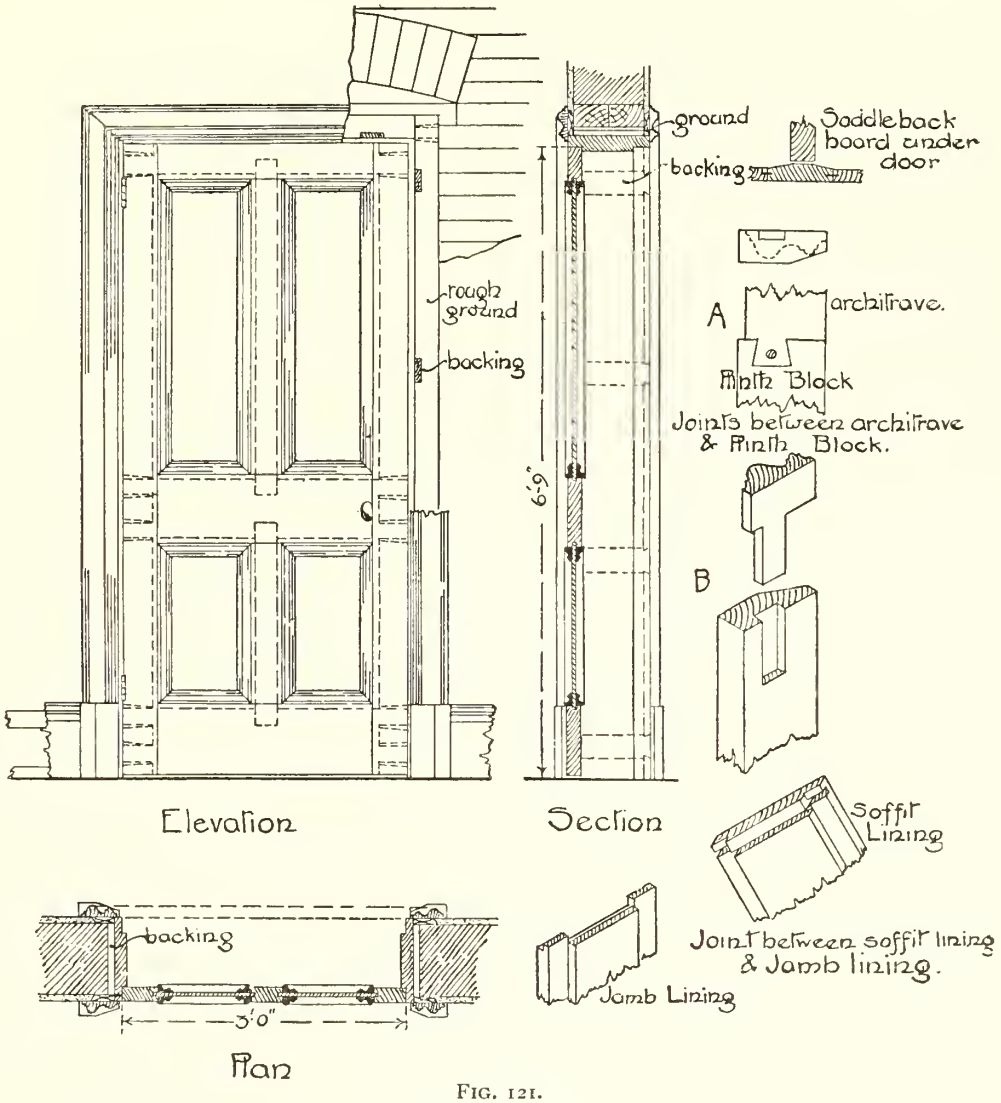


Fig. 121.

jointing the lockrail to the styles, as shown in Fig. 123, the sum of the width of the tenons being equally to one-third of the width of the rail. The inside edges of both styles and top and bottom rails are ploughed to receive panels, as are also both edges of the middle rail and the muntings. A short piece of wood is ploughed with the same iron to be used as a "Mullet"—for "Mulleting" or gauging the panels to the correct thickness previous to fitting them into the door. The rails and muntings are put together first,—in high-class work a hammer-headed tenon joint, and the transom is tenoned and wedged into the posts. The curved canopy over the doorway is supported upon rough curved ribs built up in sections, and bolted together as shown in the section AB. The curved mouldings are built up of short lengths dowelled together.

Panel Mouldings.—Doors may be moulded in several ways, and the style of moulding and methods of fixing same depend largely upon the size and thickness of door, the wood of which it is made, and the

position it occupies in a building, whether prominent or obscure. The most simple of all mouldings is that merely butting up against the rails when the panels are fixed. A slight addition to this pattern is made

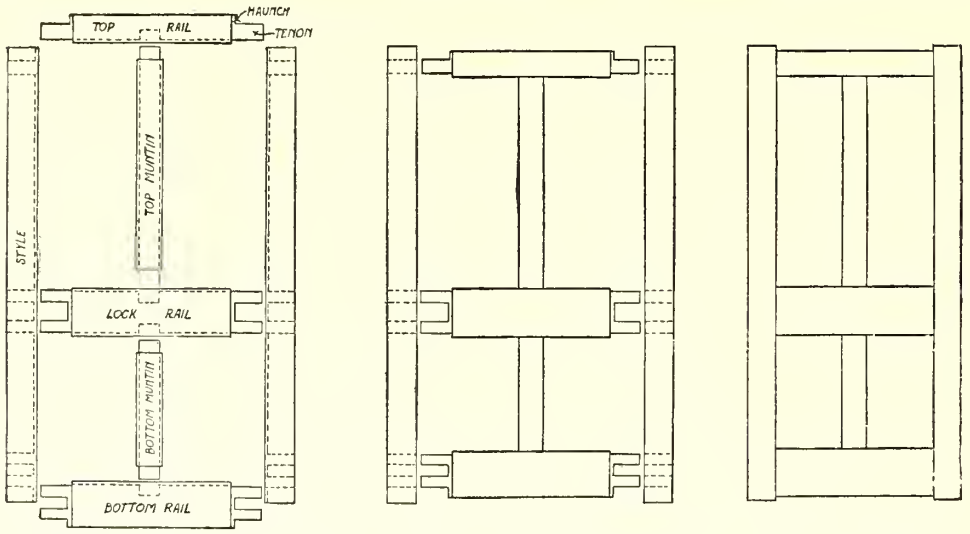


FIG. 122.

known as *Bead and Butt*, in which a bead is worked upon two opposite edges of the panels parallel with the grain, as shown in Fig. 125, the ends of the beads

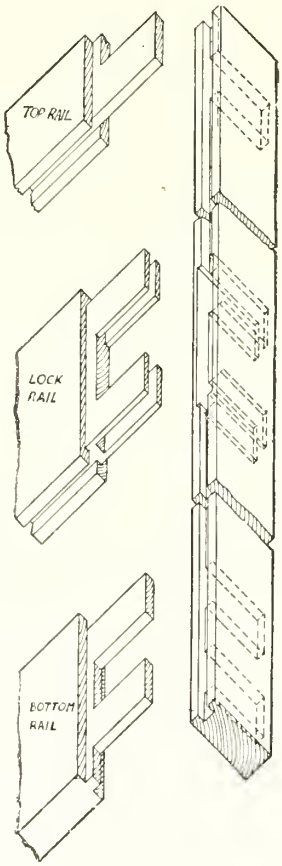


FIG. 123.

by returning the bead across the top and bottom of panels, and the door is then known as *Bead and Flush*, the way of executing this pattern being to work the beads on the framing of the door, and fit the panels up to them, as shown at A and B, Fig. 126. This method of working the mouldings on the framing—or in workshop parlance having the moulding "stuck"—is frequently adopted in preference to framing up square, and fixing separate mouldings afterwards, as shown at C. Sometimes the bead is worked upon two sides of the panel, as shown at D, Fig. 126, and a separate bead is planted on to the remaining sides. In this latter case the mouldings are said to be "planted" on.

Panels must not be fitted "home" to the bottom of the groove. They may be so lengthways, but in the width an allowance equal to $\frac{1}{8}$ of an inch per foot should be made, as dampness may cause swelling to this extent. They should also not be glued into the grooves. Wide panels are much less liable to warp if glued up in several narrow widths than if composed of single pieces. Mouldings, when planted, should not be glued to the panels, but should be bradded to the framing, so that the panel is free to move; and in order that they may bind closely to the panels the back edge should be slightly undershot, as shown at A in Fig. 127.

As brad holes should not be made in hard wood where polished, the device is adopted for fixing mouldings which is shown at B. Here a small groove is made by the side of the panel groove in the frame, the moulding being fitted in and glued to the panel in this case, as the panel may shrink and carry the moulding with it without showing an open space.

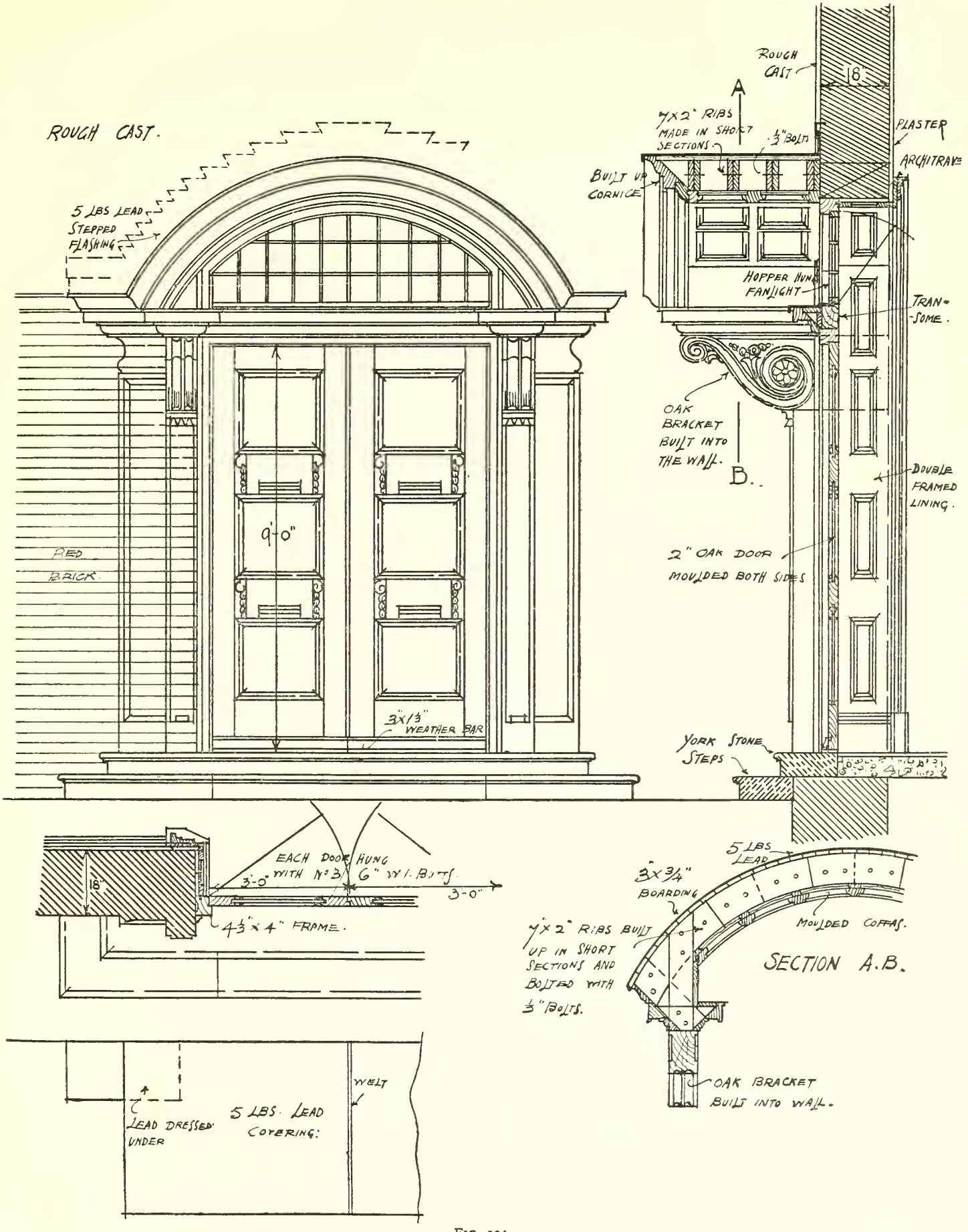

ROUGH CAST.
5 LBS LEAD STEPPED FLASHING
RED BRICK
9'-0"
3"x1/3" WEATHER BAR
ROUGH CAST
18"
A
7"x2" RIBS MADE IN SHORT SECTIONS
1/3" BOLTS
PLASTER
ARCHITRAVE
BUILT UP CORNICE
HOPPER HUNG FANLIGHT
TRANSOME.
OAK BRACKET BUILT INTO THE WALL.
B.
DOUBLE FRAMED LINING.
2" OAK DOOR MOULDED BOTH SIDES
YORK STONE STEPS
18"
EACH DOOR HUNG WITH No 3 6" W.I. BUTTS.
3'-0"
3'-0"
4 1/2" x 4" FRAME.
5 LBS LEAD
3"x3/4" BOARDING
7"x2" RIBS BUILT UP IN SHORT SECTIONS AND BOLTED WITH 1/3" BOLTS.
MOULDED COFFAS.
SECTION A.B.
OAK BRACKET BUILT INTO WALL.
WELT
LEAD DRESSED UNDER
5 LBS. LEAD COVERING.

FIG. 124.

This is only necessary *along* the panels, as across the ends the moulding may be fitted against the framing,

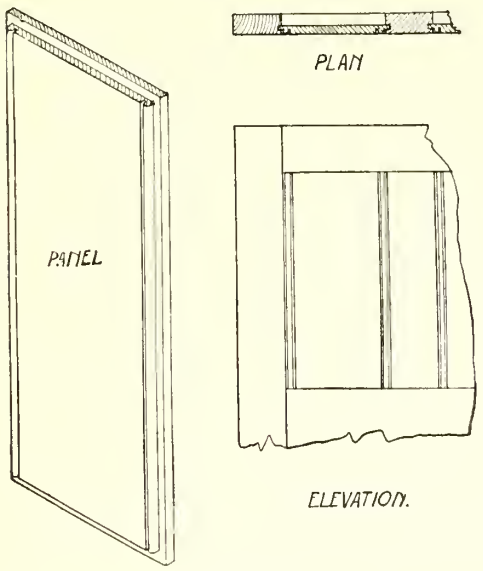


Fig. 125.

sprung into place when the side pieces are fixed, and secured by dowels.

An effective moulding, and one largely used in hard-wood doors and doors in prominent positions, is that

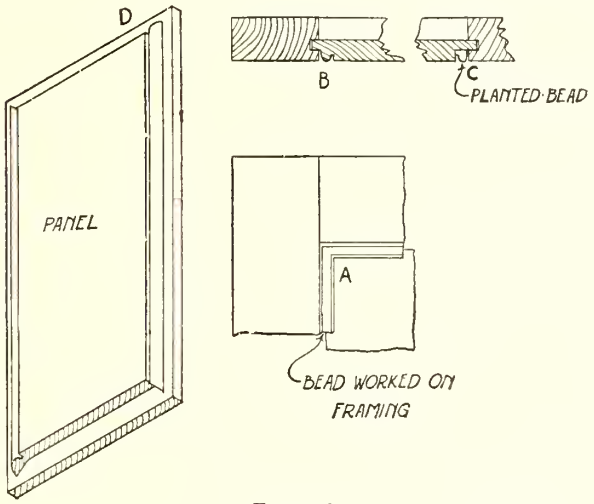


Fig. 126.

known as "Bolection." This moulding projects beyond the face of the framing, and is rebated over the edge, as shown at C in Fig. 127. This is known as *Single bolection*, where a door is so moulded on one side, and sunk moulded on the other side. Such a moulding is fixed to the panels, the proper method being by means of screws in slots put in from the back, these being hidden by the moulding on the other side. When this moulding is put to both sides of a door it is known as *Double bolection moulded*, one method of accomplishing this being shown at D in Fig. 127. The moulding is cut in one piece for both sides, tongued into the frame and grooved for panels, to which in this case it is not necessarily fixed. If fixed to each side separately one side is first slot screwed as described, and the

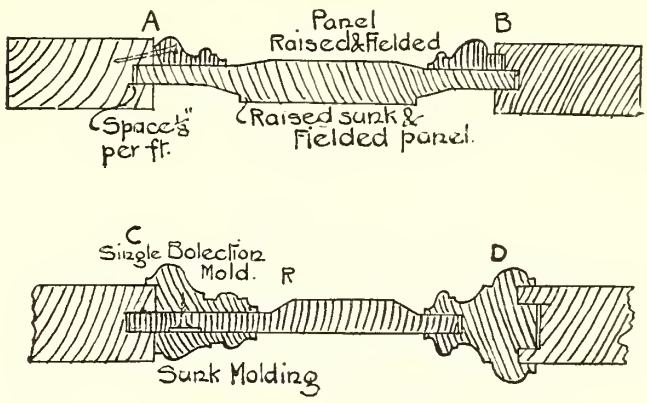


Fig. 127.

other then dowelled to the panel. The mitres should be screwed together or grooved and tongued. In Figs. 125, 126, and 127 are also shown the several methods of forming panels. Ordinary mouldings, especially at the mitres, often furnish many points of lodgment for dust, and in hospitals and places where dust is liable to convey infection special mouldings and panels having rounded corners are designed so as to be easily cleaned.

The adoption of hard woods in the construction of doors is becoming more general, especially in the case of *built-up* doors, where pine is used as a foundation, covered with some selected hard wood. In some cases the covering is more than ordinary veneer, and can hardly be classed as such in the general acceptation of that term. An excellent example of this construction is shown in Fig. 128, where the

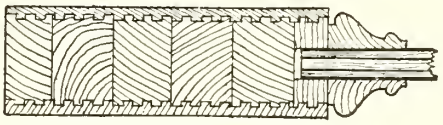


Fig. 128.

"core" is made in strips of pine with the grain reversed and dried with two hundred degrees of heat, the hard-wood facing being welded to the core by immense pressure. These doors are made by the Gilmour Door Company Ltd., who guarantee them against showing any defects.

Where openings are too wide to be fitted with one door, *Double Doors*, or a *Pair of Doors* are fixed. These are constructed separately as single doors, and the styles coming together are called *Meeting Styles*. In single doors the style to which the hinges are attached is called the *Hanging Style*, that containing the lock the *Striking Style*. A rail between the top and lock-rails is called the *Frieze-rail*.

In openings which are too wide for a single door and not wide enough for double doors it is usual to put a

Double-Margin Door, which consists of two narrow single doors joined together at their meeting styles, and as the construction is a little more complicated than that of the ordinary door, a sketch of the meeting styles is shown in Fig. 129. The two halves having been prepared in the ordinary way, the meeting styles are ploughed for tongues, and have three mortises made as indicated, and also a small rebate on each side of the meeting edges. The outside styles are knocked on dry, and the rails are glued and wedged into the meeting styles. The ends of tenons and wedges being cut slightly back from the face, the tongues are glued in and the styles cramped up, hard-wood folding wedges being glued and driven into the mortises as shown. When all has set the ends of the wedges are

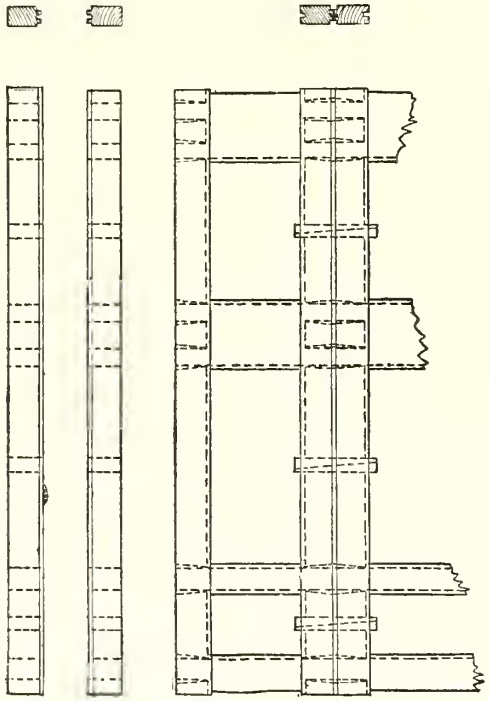


Fig. 129.

cut off, and the door is completed in the ordinary way. These doors may be strengthened by a flat iron bar let into the top and bottom rails.

The styles of doors are sometimes reduced in width in the upper portion, the diminishing usually taking place at the lock-rail, which is then cut with a bevel shoulder, as shown in Plate IV. This form of style is generally adopted with doors which are glazed above the lock-rail.

It is sometimes desired to construct a door in such a position that its presence is not noticed, and where an ordinary opening and door would spoil the effect of wall decoration or framing. In this case what is known as a *Jib Door* is used. It may consist of an ordinary framed and panelled door, but is so arranged that any decoration or mouldings on the wall may be continued uninterruptedly across its face.

The process of fixing a door into its frame or linings is known as "Hanging." Main entrance and all interior doors are generally hung on "butt hinges, which have square or butt ends and are let into the wood, as distinguished from hinges fixed on the surface.

There are two ways of arranging the swing of a door when hanging,—one known as "Close-joint hanging," in which a close joint is maintained between the door and lining, in all positions of the door; and the other known as "Open-joint hanging," in which there is a varying opening between the door and lining. The difference is effected in the arrangement of the hinge, as shown in Fig. 130. When hanging a door it must first be marked out from the opening and shot to size, joint allowance being made according to the class of door. With a well-seasoned pine door nearly $\frac{1}{8}$ of an inch may be allowed on each side, and $\frac{1}{16}$ of an inch at top, but with a polished hard-wood door not more than $\frac{1}{32}$ of an inch at sides and top, the bottom allowance in each case depending upon whether thick floor covering has to be provided for or not. Having marked out the positions of and fitted and screwed on the hinges, they are opened out flat and the door placed

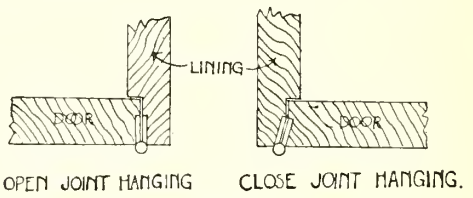


Fig. 130.

in the opening, two small wedges under the bottom and one on each side near the top being used to bring it to its exact position. The sinkings for hinges are then marked on the linings, the door removed, and the sinkings cut out. The wings of hinges are then fitted into their places and one screw fixed in each, the door being held half open on the wedges. The swing is then tried, and if any adjustment is required it can be made by a slight alteration in either the top or bottom hinge.

Doors are hung either right or left handed. If, when facing a door which opens towards you, the hinges are on the left-hand side, it is a "left-handed" door, and *vice versâ*.

There is an endless variety in the patterns of butts with which doors may be hung. The best quality brass butts are now made with steel lining and spindle and steel-washered joints, a recent introduction being a butt with steel-washered ball-bearing joints, which ensure the easy swinging of heavy doors. Doors which are required to open over thick floor coverings and at the same time fit close to the floor when shut should have saddle boards, as shown on section in Fig. 121, fitted under them; or when the floor covering does not commence for some distance away from the closed

position of the door, *Rising Butts* may be used for the same purpose. These are made with a spiral joint, which causes the door to rise while it is being opened, and to shut automatically. For positions where there is much traffic *Swing Doors* are usually provided. These may be either single or double doors, opening either way, and fitted with a spring hinge let into floor; or in cases where it is not desired to cut the floor there is a pattern which can be fixed above the floor.

room would cause obstruction and be inconvenient. "Sliding doors" are then if possible arranged. They may be made to slide along the face of the wall, but it is much better to have them slide into a covered chase in the wall, or partition, as in Fig. 131, if it can be managed. For this a running bar or track is required, supported at each end, and in the case of double doors in the middle also. This is usually rounded on the top, and carries hollow-edged friction rollers, which are

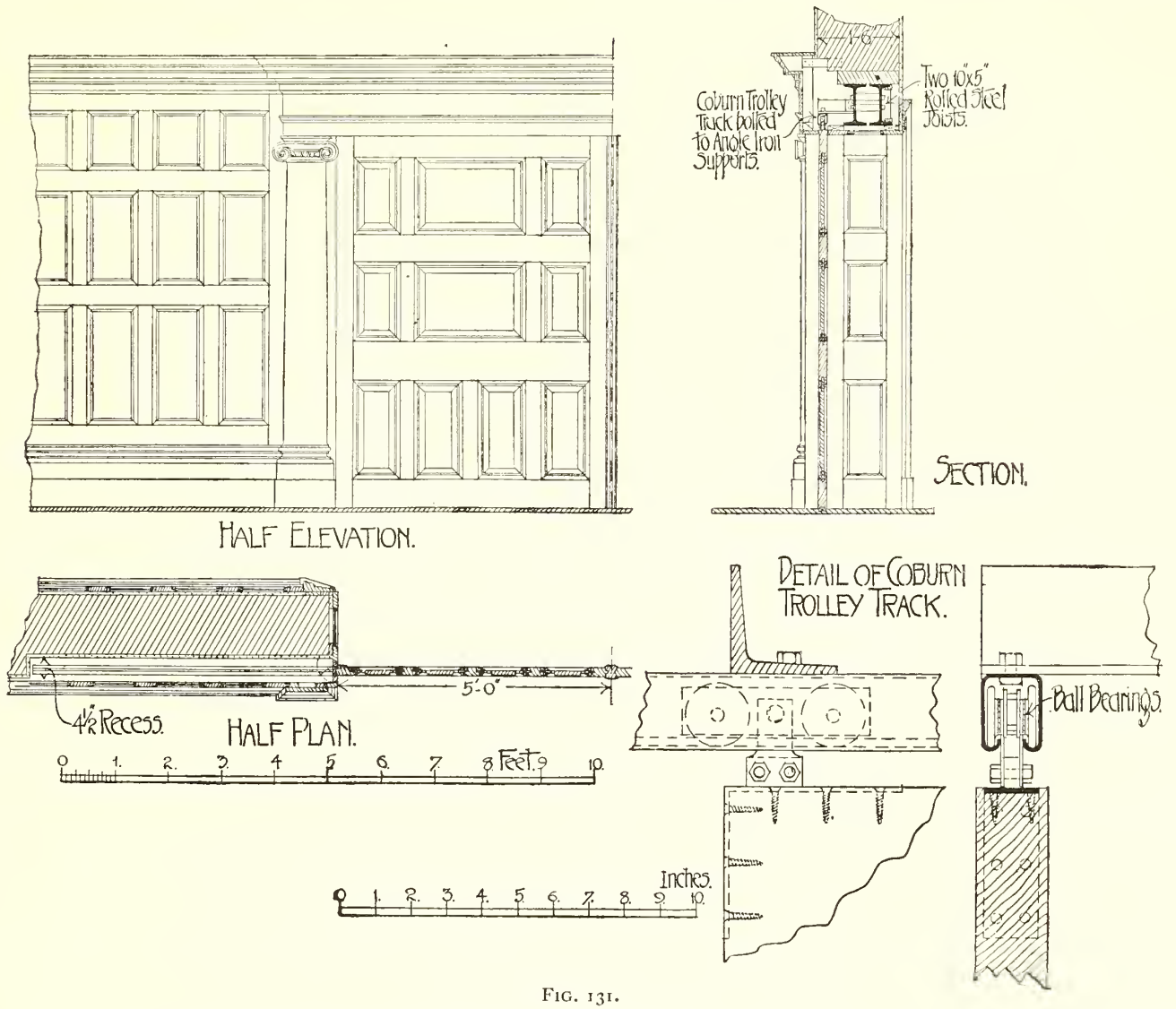

Coburn Trolley Track bolted to Angle Iron Supports.
Two 10"x5" Rolled Steel Joists.
SECTION.
HALF ELEVATION.
DETAIL OF COBURN TROLLEY TRACK.
5'-0"
4½ Recess.
HALF PLAN.
0 1. 2. 3. 4 5 6. 7 8 Feet. 9 10.
Ball Bearings.
Inches.
0 1. 2. 3. 4. 5 6. 7. 8. 9 10.

FIG. 131.

"Helical spring butts" are a simple device for hanging a swing door, and can be provided with single or double action.

Borrowing an idea from the ancient Egyptians, doors are sometimes hung on top and bottom centres, or "Pintles." These, fixed at the middle of the top and bottom rails, cause the door to revolve, giving a passage on either side. This is known as a *Butterfly Door*.

Sometimes cases occur where doors opening into a

contained in brackets attached to the top of the door. The bottoms of doors should also be provided with hollow-edged guide rollers, running on a guide fixed flush with the floor or metal tongue running in a groove. The doors may be made to open and close simultaneously by means of flexible wire cords running from one door to the other through pulleys at the ends; or rack bars may be fixed to each, and actuated by a pinion fixed to the centre support of running bar.

CHAPTER IV

WINDOWS, FRAMINGS, ETC.

(*Contributed by H. Kennard*)

Although there are numerous forms and varieties of windows, they may, generally speaking, all be classed under one of two heads: "Sash Windows" and "Casements," the framing to each class being known respectively as *Cased* and *Solid*.

Sash Windows.—The type of window in most general use, and one that is perhaps distinctly British, is that known as the *Cased Sash Frame*. This consists of a frame built hollow in order to contain the weights which counter-balance the sashes. Two sashes are fitted, and according to whether one or both are hung on pulleys with weights the window is described as "single" or

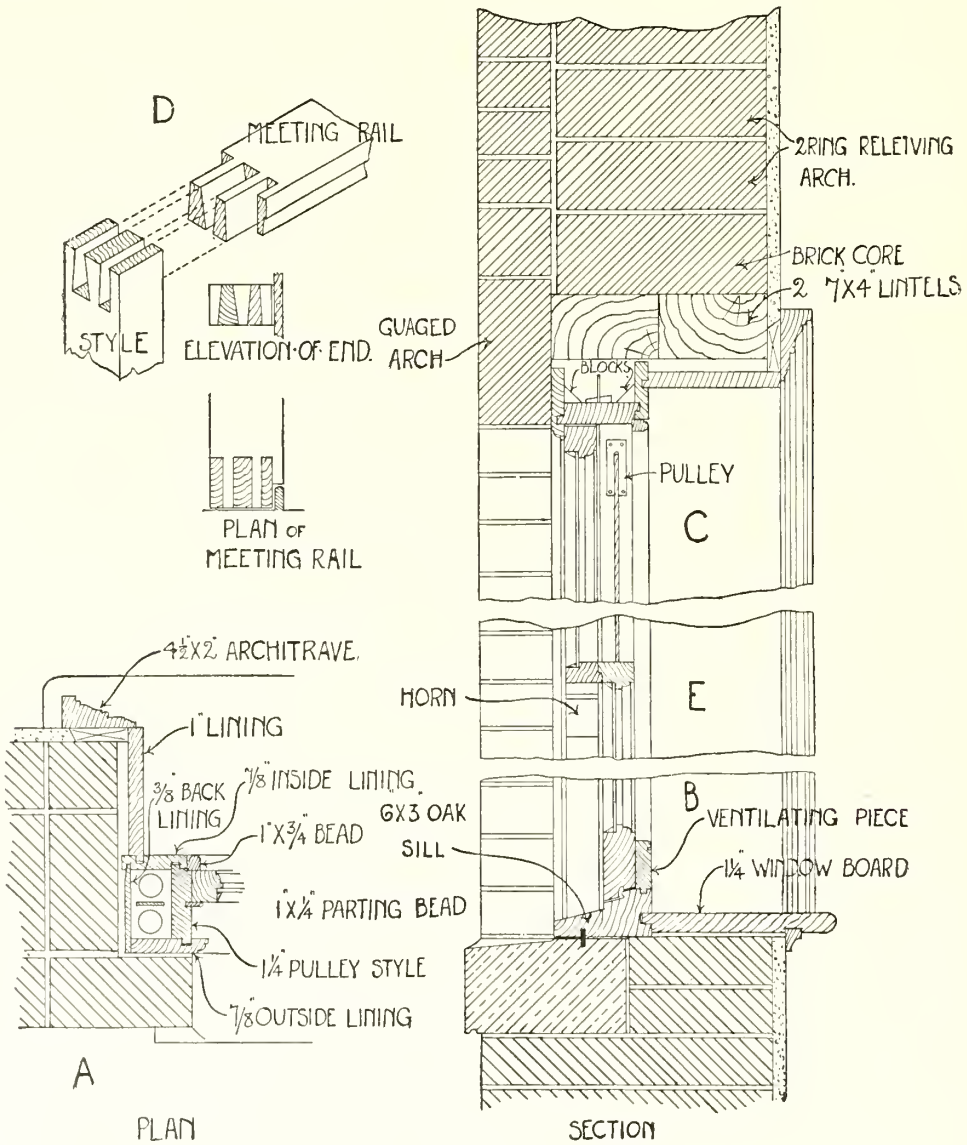


Fig. 132.

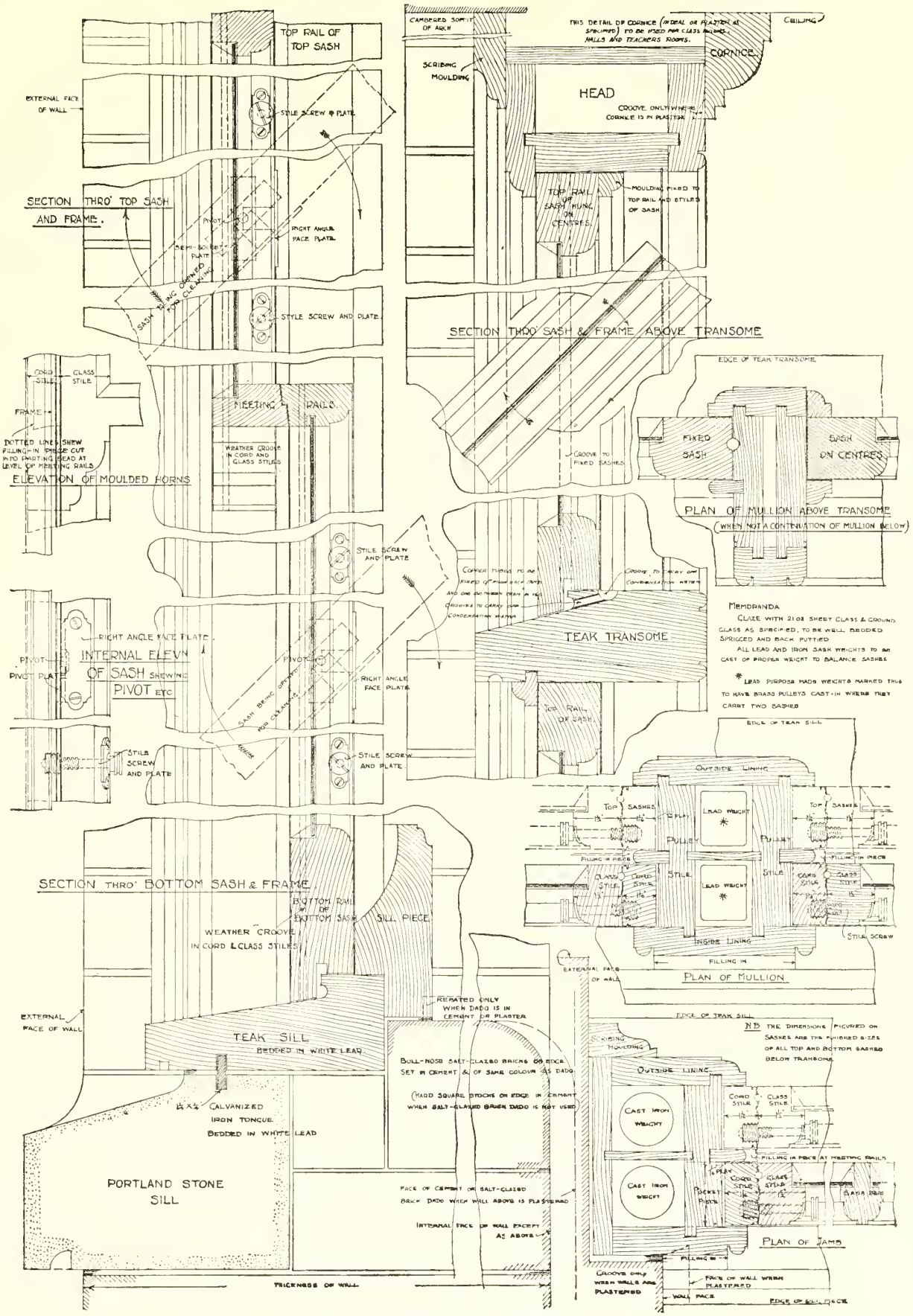

TOP RAIL OF TOP SASH
EXTERNAL FACE OF WALL
STILE SCREW & PLATE
SECTION THRO' TOP SASH AND FRAME.
PIVOT
RIGHT ANGLE FACE PLATE
SEMI-BOXED PLATE
SASH SWING OPENED FOR CLEANING
STYLE SCREW AND PLATE
CAMBERED SOFFIT OF ARCH
SCRIBING MOULDING
THIS DETAIL OF CORNICE (IN DEAL OR PLASTER AS SPECIFIED) TO BE FIXED IN CLASS ROOMS HALLS AND TEACHERS ROOMS.
CEILING
CORNICE
HEAD
GROOVE ONLY WHERE CORNICE IS IN PLASTER
TOP RAIL OF SASH MUNTIN ON CENTRES
MOULDING FIXED TO TOP RAIL AND STYLES OF SASH
SECTION THRO' SASH & FRAME ABOVE TRANSOME
EDGE OF TEAK TRANSOME
FIXED SASH
SASH ON CENTRES
PLAN OF MULLION ABOVE TRANSOME
(WHEN NOT A CONTINUATION OF MULLION BELOW)
CORD STILE
GLASS STILE
FRAME
MEETING RAILS
DOTTED LINES SHEW FILLING-IN PIECE CUT IN TO RABBETING BEAD AT LEVEL OF MEETING RAILS
WEATHER GROOVE IN CORD AND GLASS STILES
ELEVATION OF MOULDED HORNS
GROOVE TO FIXED SASHES
STILE SCREW AND PLATE
COPPER TUBES TO BE FIXED AT FOUR BACK JAMBS AND ONE ON THREE FRONT IN THE GROOVES TO CARRY OFF CONDENSATION WATER
GROOVE TO CARRY OFF CONDENSATION WATER
TEAK TRANSOME
MEMORANDA
GLAZE WITH 21 OZ SHEET GLASS & GROUND GLASS AS SPECIFIED, TO BE WELL BEDDED SPRIGGED AND BACK PUTTIED
ALL LEAD AND IRON SASH WEIGHTS TO BE CAST OF PROPER WEIGHT TO BALANCE SASHES
* LEAD PURPOSE MADE WEIGHTS MARKED THUS * TO HAVE BRASS PULLEYS CAST-IN WHERE THEY CARRY TWO SASHES
RIGHT ANGLE FACE PLATE
INTERNAL ELEVN OF SASH SHEWING PIVOT ETC
PIVOT PLATE
PIVOT
RIGHT ANGLE FACE PLATE
SASH SWING OPENED FOR CLEANING
STILE SCREW AND PLATE
STILE SCREW AND PLATE
EDGE OF TEAK SILL
OUTSIDE LINING
TOP SASHES
PLAY
LEAD WEIGHT
PULLEY
PULLEY
TOP SASHES
FILLING IN PIECE
CLASS STILE
CORD STILE
STILE
LEAD WEIGHT
STILE
CORD STILE
CLASS STILE
FILLING IN PIECE
INSIDE LINING
STILE SCREW
FILLING IN
PLAN OF MULLION
SECTION THRO' BOTTOM SASH & FRAME
BOTTOM RAIL OF BOTTOM SASH
SILL PIECE
WEATHER GROOVE IN CORD & CLASS STILES
EXTERNAL FACE OF WALL
REBATED ONLY WHEN DADO IS IN CEMENT OR PLASTER
EDGE OF TEAK SILL
NB THE DIMENSIONS FIGURED ON SASHES ARE THE FINISHED SIZES OF ALL TOP AND BOTTOM SASHES BELOW TRANSOME
SCRIBING MOULDING
OUTSIDE LINING
TEAK SILL
BEDDED IN WHITE LEAD
BULL-NOSE SALT-GLAZED BRICKS ON EDGE SET IN CEMENT & OF SAME COLOUR AS DADO
(HARD SQUARE STOCKS ON EDGE IN CEMENT WHEN SALT-GLAZED BRICK DADO IS NOT USED)
CAST IRON WEIGHT
CORD STILE
CLASS STILE
FILLING IN PIECE AT MEETING RAILS
PLAY
CORD STILE
CLASS STILE
SASH BEAD
POCKET PIECE
CAST IRON WEIGHT
PLAN OF JAMB
GALVANIZED IRON TONGUE BEDDED IN WHITE LEAD
PORTLAND STONE SILL
FACE OF CEMENT OR SALT-GLAZED BRICK DADO WHEN WALL ABOVE IS PLASTERED
INTERNAL FACE OF WALL EXCEPT AS ABOVE
THICKNESS OF WALL
GROOVE ONLY WHEN WALLS ARE PLASTERED
FILLING IN
FACE OF WALL WHEN PLASTERED
WALL FACE
EDGE OF SILL PIECE

FIG. 133.—REVERSIBLE WINDOWS.

"double" hung. Plate IV. shows a double-hung sash window in plan, section, and elevation; while A, Fig. 132, is an enlarged plan of one side of the cased sash frame showing the various parts. B is a section through sill showing the method of forming this, and also giving a portion of bottom sash. It will be noticed that this detail varies slightly in one or two points from windows as generally made. The guard beads are frequently planted on flush with the pulley style, and are of the same thickness as the lining. As here shown, they are slightly thicker than the lining, and so cover the joint between lining and style, and are also rebated a little way into the pulley style. They should be screwed, and never bradded on, as they can then be easily removed and replaced without damage. The screws should be fitted with cups. The piece marked V is sometimes called a "Ventilating Piece." Windows fitted with this require an extra deep rail to the bottom sash. The lower sash may then be raised, so as to secure ventilation between the meeting rails without the risk of draught at the bottom. The sills of windows should be made of some wood capable of withstanding the effects of weather; oak being most generally used, although teak is preferable. They should be shaped as shown in section to throw off all wet, the technical description of such a sill as is shown being "double-sunk, weathered, and throated, and grooved for water bar, ventilating piece, and window board." The "*Water* bar" or "*Weather* bar" is a flat bar of copper or galvanised iron running the full length of the sill and fitting between the wood and stone sills, its object being to stop wet from driving in. The "Window board" is a ledge or shelf forming a finishing to the inside of window, the width varying according to circumstances. A section through the "Head" or top of the window is shown at C.

The following is the most approved method of building up a sash frame. After the parts have all been prepared, the pulley styles are first fitted into the sill, keyed up tight by means of a wedge, and nailed,—they must be perfectly upright and parallel, technically "Out of winding,"—and the head is next nailed on. It is then laid on the bench and tested for correctness across opposite angles by means of a small rod having a wedge-shaped end to fit in the angles. The inside linings are then fixed, by means of skew brads through their edges, into the pulley style, the guard beads subsequently covering the brad heads. These beads are fitted next, being mitred in, the head and sill beads being fixed first, and the side ones sprung in afterwards. The frame is then turned over, and the parting beads are fitted in. The outside linings are next fitted and fixed, the parting slips which divide the weights inserted, the back lining nailed on, and the head glue-blocked; it is then ready for fitting in the sashes.

These windows are not without some disadvantages, an annoying one being their tendency to rattle, owing to the sashes becoming too loose through slight shrinkage. A more dangerous one, however, is the difficulty of reaching the outsides for cleaning, especially when on a first or second floor. The first of these defects may be remedied by a small fitting made for the purpose, consisting of a milled head screw with leather pad working through a bracket screwed to the guard bead. The National Accident Prevention Window Company, known as the "N.A.P.," have surmounted the second difficulty by introducing sashes with double styles, inner styles containing the glass, and the outer ones being hung in the usual way. The two styles are connected by means of thumb screws, which, upon being released, permit the sash to be revolved upon centres, thus bringing the outside of the glass within easy reach (see Fig. 133). It is advisable to have all sash frames in inaccessible places fitted with this or some similar arrangement.

In putting sashes together, the top and bottom rails are haunched and tenoned into the styles, the meeting rail of top sash being tenoned and the styles usually having the "horns" left on and moulded, these being sometimes called Brackets. The meeting rail of the bottom sash is, or should be, dovetailed, as shown at D, but they are sometimes slot tenoned and screwed in common work. The meeting rails are wider than the styles by the thickness of the parting bead, and are closed by a bevel rebated joint, as at E. Windows are usually finished inside by having an architrave fixed round them to match that round the door, and stopped on the window board.

The method of arranging sash frames in a bay window is shown in Plate IV. The angles between the frames are covered with double mouldings, and at the angles between outer frames and walls grounds are fixed, an additional lining and angle moulding forming an architrave. The section through jamb as shown differs slightly in detail from that at A in Fig. 132, and illustrates an alternative method of fixing the back lining, which would necessitate its being fixed before the outside lining, instead of as previously described. The guard bead is here shown the same thickness as

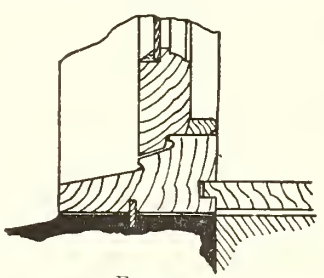


Fig. 134.

lining. The section through sill shows the usual method of fixing a small guard bead when only a shallow bottom rail is used. An improvement upon this is shown in Fig. 134, which has the effect of throwing the bottom sash tight against the parting beads, and thus lessening the risk of rattling. When the window

board is wide, as is the case shown in Plate IV., it is necessary to provide a supporting moulding as shown.

Casement Windows are constructed of solid parts, and may be fitted with sashes either fixed or hung on butts or centres. The simplest form of solid frame consists of *Side Posts*, also called *Jambs*, *Head*, and *Sill*; but by the introduction of vertical members between the posts, called *Mullions*, and horizontal members between the head and sill, called *Transoms*, these frames may be made to any size required. There should be no planted mouldings, all the parts being moulded in the solid. Mortise and tenon joints are used, and all should be put together with white lead.

The sashes in solid frames may be hung in several ways. The lower sashes are usually hung by the styles on butts, and to open either outward or inward as desired. This is called "Casement hung." Fig. 135 shows the construction of a casement window in which outward and inward opening sashes are illustrated, together with an inward opening fanlight. In frames containing transoms the upper sashes, when fitted with butts, are generally hung by the bottom rail, and open inwards; when hung by the top they open outwards; and when on centres, the top falls in and the bottom out. They are actuated from the floor by means of cords, and there are various patterns of

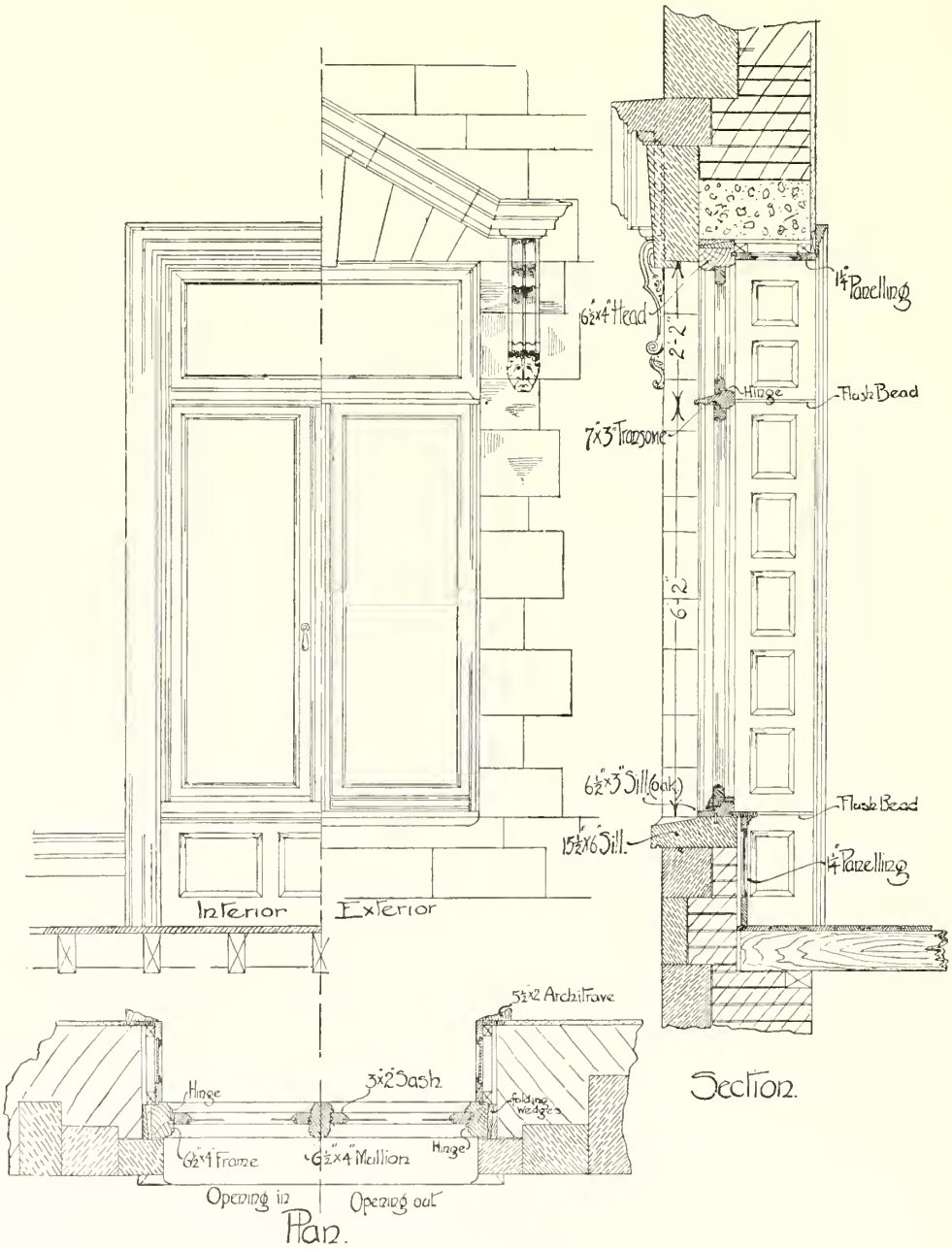


Fig. 135.

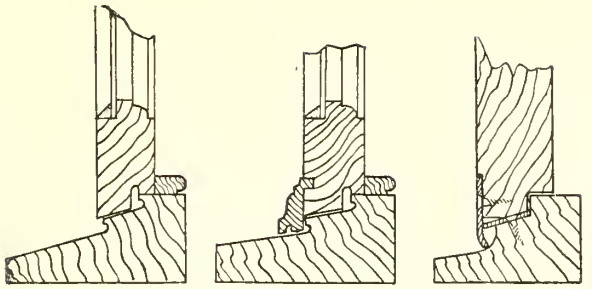


FIG. 136.

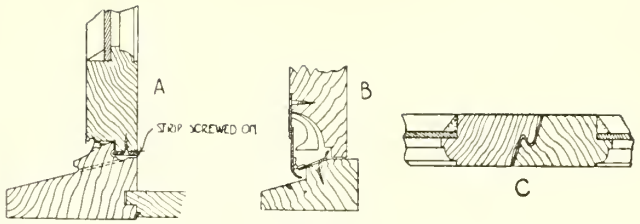


FIG. 137.

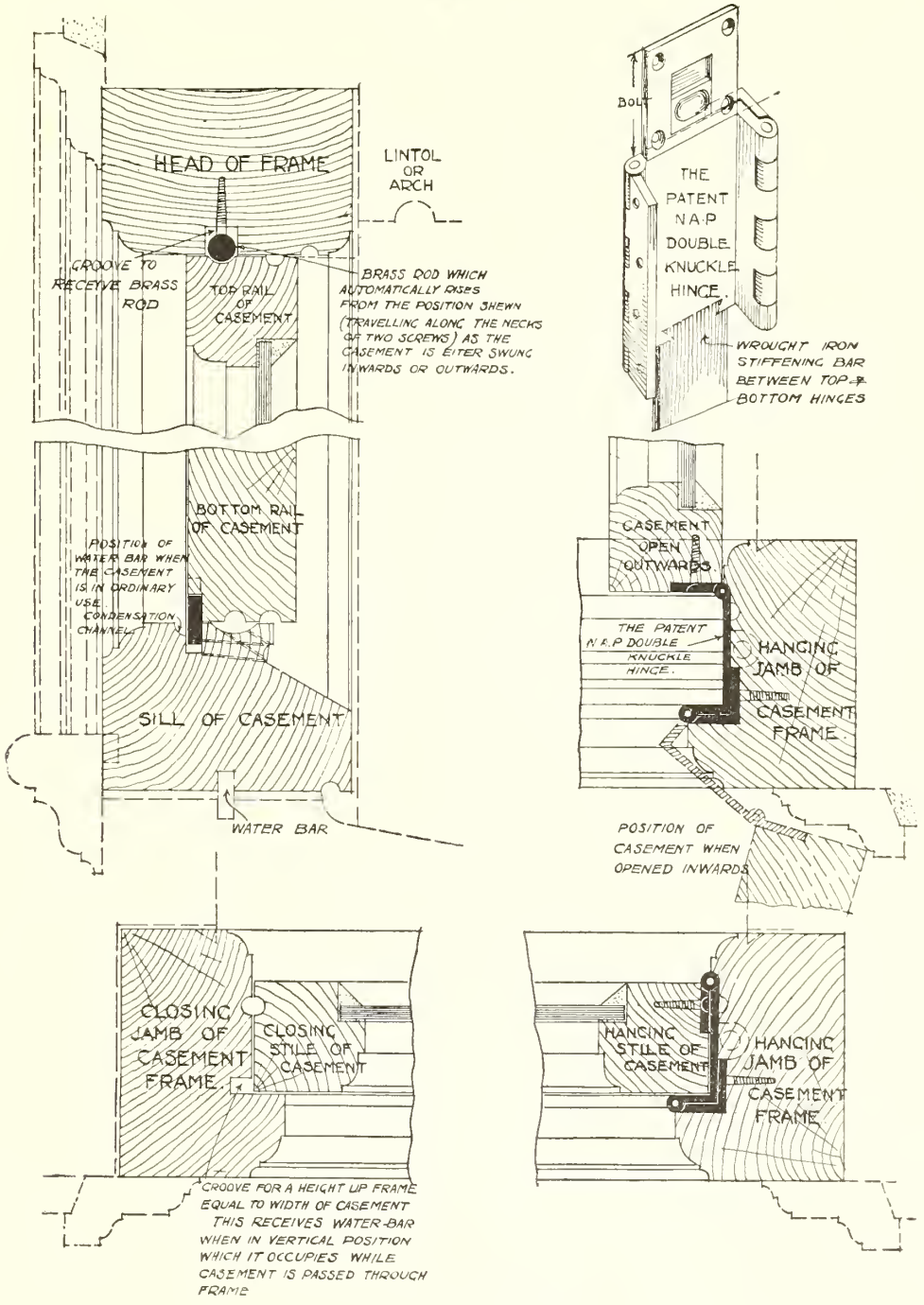

HEAD OF FRAME
LINTOL OR ARCH
GROOVE TO RECEIVE BRASS ROD
TOP RAIL OF CASEMENT
BRASS ROD WHICH AUTOMATICALLY RISES FROM THE POSITION SHEWN (TRAVELLING ALONG THE NECKS OF TWO SCREWS) AS THE CASEMENT IS EITER SWUNG INWARDS OR OUTWARDS.
BOLT
THE PATENT N.A.P DOUBLE KNUCKLE HINGE.
WROUGHT IRON STIFFENING BAR BETWEEN TOP & BOTTOM HINGES
BOTTOM RAIL OF CASEMENT
POSITION OF WATER BAR WHEN THE CASEMENT IS IN ORDINARY USE.
CONDENSATION CHANNEL
SILL OF CASEMENT
WATER BAR
CASEMENT OPEN OUTWARDS
THE PATENT N.A.P DOUBLE KNUCKLE HINGE.
HANGING JAMB OF CASEMENT FRAME.
POSITION OF CASEMENT WHEN OPENED INWARDS
CLOSING JAMB OF CASEMENT FRAME.
CLOSING STILE OF CASEMENT
HANGING STILE OF CASEMENT
HANGING JAMB OF CASEMENT FRAME
GROOVE FOR A HEIGHT UP FRAME EQUAL TO WIDTH OF CASEMENT THIS RECEIVES WATER-BAR WHEN IN VERTICAL POSITION WHICH IT OCCUPIES WHILE CASEMENT IS PASSED THROUGH FRAME

FIG. 138.—CASEMENTS.

openers and stays. One of the most approved consists of a worm wheel and rack stay bar, by means of which the sash may be gradually opened and fixed at any required position. The general difficulty experienced with casement frames is in making them weathertight. This is more particularly the case when the sashes open inward. When opening outward, the bottom bar may be check-throated and be cut to fit the weathering of sill, and an additional weather board is sometimes fixed to the bottom bar.

Fig. 136 shows some methods of fitting an outward opening casement. When opening inwards, the bottom bar must necessarily clear the highest point of sill, so that the above weatherings cannot be adopted, while another point that has to be considered is that the wind has a continual tendency to force the sash open. Care must be taken when this joint is used that the rails are double tenoned into the meeting styles, so that the hook may be worked between them. If a single tenon only be used, the hook would cut through the end of it, which would then break off.

The difficulty of cleaning the outsides of casements opening outward may be overcome by the adoption of a double-action hinge, which allows the sash to be turned into the room. This hinge is a patent of the N.A.P. Window Company, and is illustrated in Fig. 138, together with the complete casement. Other forms of windows which are fitted in solid frames are known as :—

Bulls Eye Light (Fig. 139). In this the frame is circular, the usual method of construction being to cut the circle in three segments, jointed with hand-rail bolts ;

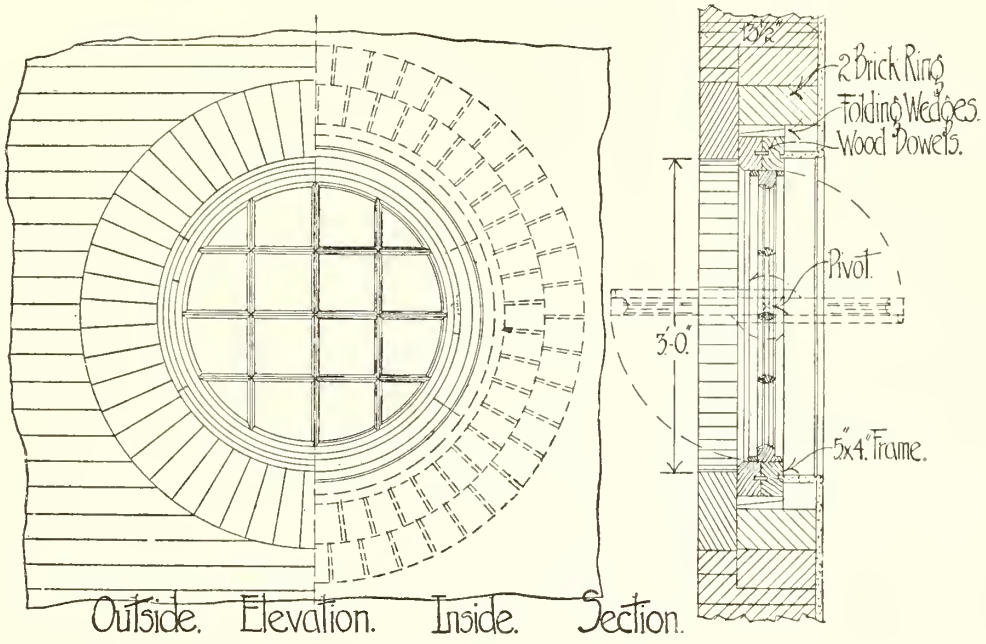


Fig. 139.

Fig. 137 shows two methods of fitting the bottom bar for inward opening. A shows all the construction of wood. Here a double check is provided, so that any water driven beyond the first groove drops into the second and is carried off through the weep holes, which are indicated by dotted lines. Several of these holes are made in the length of the sill. At B a metal bar with a hinged flap is shown. This bar is screwed to the sill, and when the sash is open the flap lies closed. When the sash is closed this flap is caught by the hook attached to the plate, which runs the full length of the bottom bar and is raised to the position shown, thus excluding all wet ; but it may be mentioned that exact adjustment, such as is rarely maintained for long with framed timber, is necessary for this to act properly. The meeting style of casement sashes should be closed with what is known as a "Hook Joint," such as is shown at C. It is superior to a bevel rebated joint. it is made in two thicknesses, which are fixed to break-joint. The sash is also made in segments, and the guard beads may, if the diameter is small, be cut in two semicircles from a wide board, or be steamed and bent to shape. If required to open, the sash is hung on pivots, the upper part of the inner bead being attached to the upper half which falls inwards, and the outer bead having its lower part attached to the lower part of the sash.

Hospital Lights.—This is a term applied to a frame fitted with several sashes, fixed one above another, and hung by the bottom bars, so that either or all may be opened for ventilation as desired. The name originates from the fact that this class of light is largely adopted in hospitals. They are sometimes called "Hopper Frame Lights."

Yorkshire Lights consist of a long low frame having one or two mullions. If one mullion, a sash

is fitted to one half of the frame and made to slide horizontally on runners, the other half having the glass fixed in the frame. If two mullions are used the sash is generally placed in the middle, the outside lights being glazed direct in the frame.

Cases frequently occur where it is necessary to provide windows, or lights, in the roof of a building, and this may be accomplished in one of three ways,—namely, by means of DORMER WINDOWS, SKYLIGHTS, or LANTERN LIGHTS.

Dormer Windows vary only from those previously mentioned in that they are placed in a special projection, or Dormer, formed in the roof. Cased sash frames or solid frames may be used, and the details of construction are similar to those before described for each class. Preparation for dormer windows has to be made when the roofs are constructed by the insertion of trimmers.

Skylights are sashes fixed in the roof, following the same slope as the roof. Their exposed position necessitates careful construction and fixing in order to avoid the risk of leakage. To form the opening for a skylight in the rafters, it is necessary to insert two trimmers. A "Lining" or "Curb" is then fixed to the rafters and trimmers. This curb may be rough, and be covered on the inside with a thin lining, or the inside face may be wrought and the bottom edge moulded, usually with a large bead, while the joints at corners should be dovetailed. The curb should be wide enough to stand from 5 to 6 inches above the finished surface of the roof, lead being dressed round it, carried over the top edge and fixed by close copper nailing. When the light is hung it is by the top bar, and in this case a small gutter is sometimes fixed inside the curb to catch any water driving through the top joint. The sash should be out of at least 2-inch stuff, and should overhang the curb from 2 to 3 inches all round, and have a "throat" worked on the under side. The method of putting together is shown in Fig. 140. The bottom bar is thinner than the top and sides, the upper side of it being level with the rebates, so that the glass may run over it. Slight dishings or grooves are formed in it under each pane to carry off any condensation moisture. The top bar is grooved instead of being rebated, for glass as a putty joint at this point would be liable to fail. The glass is secured at the bottom rail by means of copper clips. It should only be lapped over this rail sufficiently to ensure a weathertight joint, as, if it be carried to the bottom as is frequently done, the sun's rays are focused through it on to the rail, causing the latter to warp, with the risk of splitting the glass.

A *Lantern Light* is an elaboration of the skylight, and consists practically of a glazed roof, supported upon glazed sides, standing above the roof proper. Such lights are built principally in the roofs of billiard rooms and halls, or in positions where an abundance of top light is required. They are made to various designs, and in plan may be square, rectangular, polygonal, or circular. The opening in the roof is formed by cutting and trimming the rafters, and a stout curb is fixed to carry the sides of the lantern. This curb is usually rough, and faced inside with wrought and moulded, or framed and panelled lining,

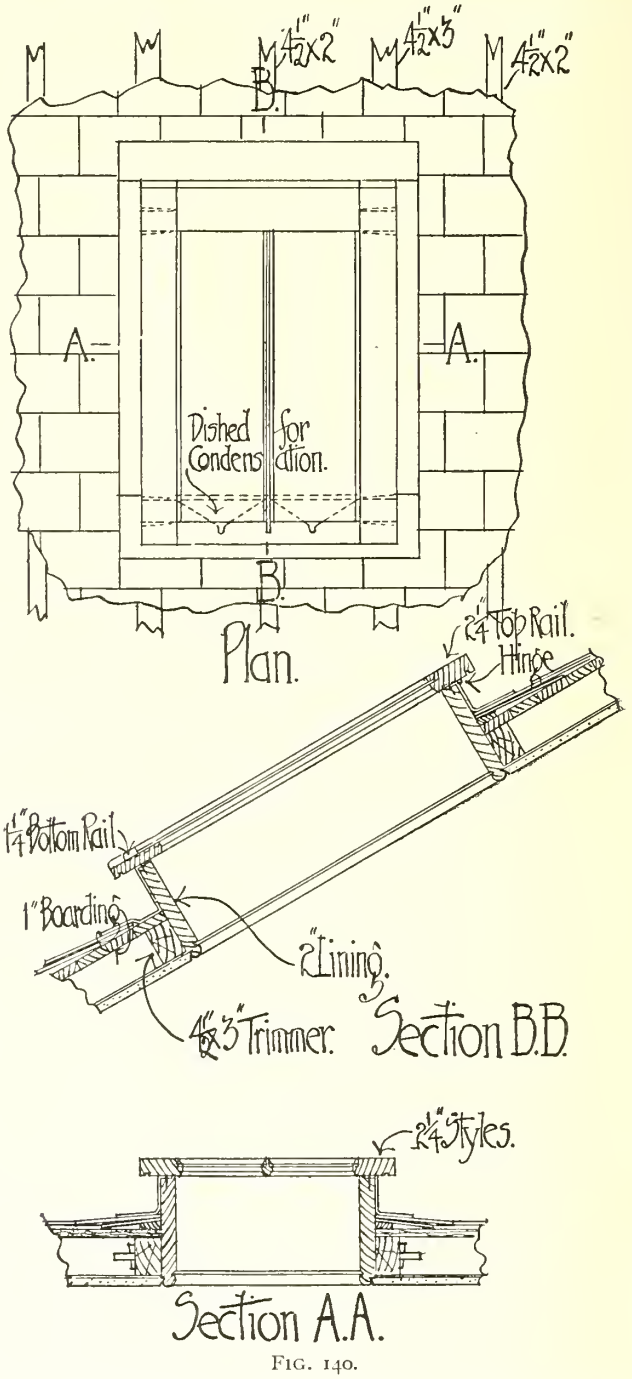


FIG. 140.

and carries the sill of the side lights. Lead is dressed up the outside of the curb and over the top edge, and may be turned up into a groove made in the sill to receive it, as shown at A in Fig. 141, or a fillet may be nailed along the top of the curb, the lead dressed over this, and the sill grooved to fit over the whole as shown

at B. In a rectangular lantern the sides are generally made in the form of solid frames with mullions, the corner posts being double rebated so as to each take two sides. The sill should be wide enough to overhang the curb inside to a distance equal to the

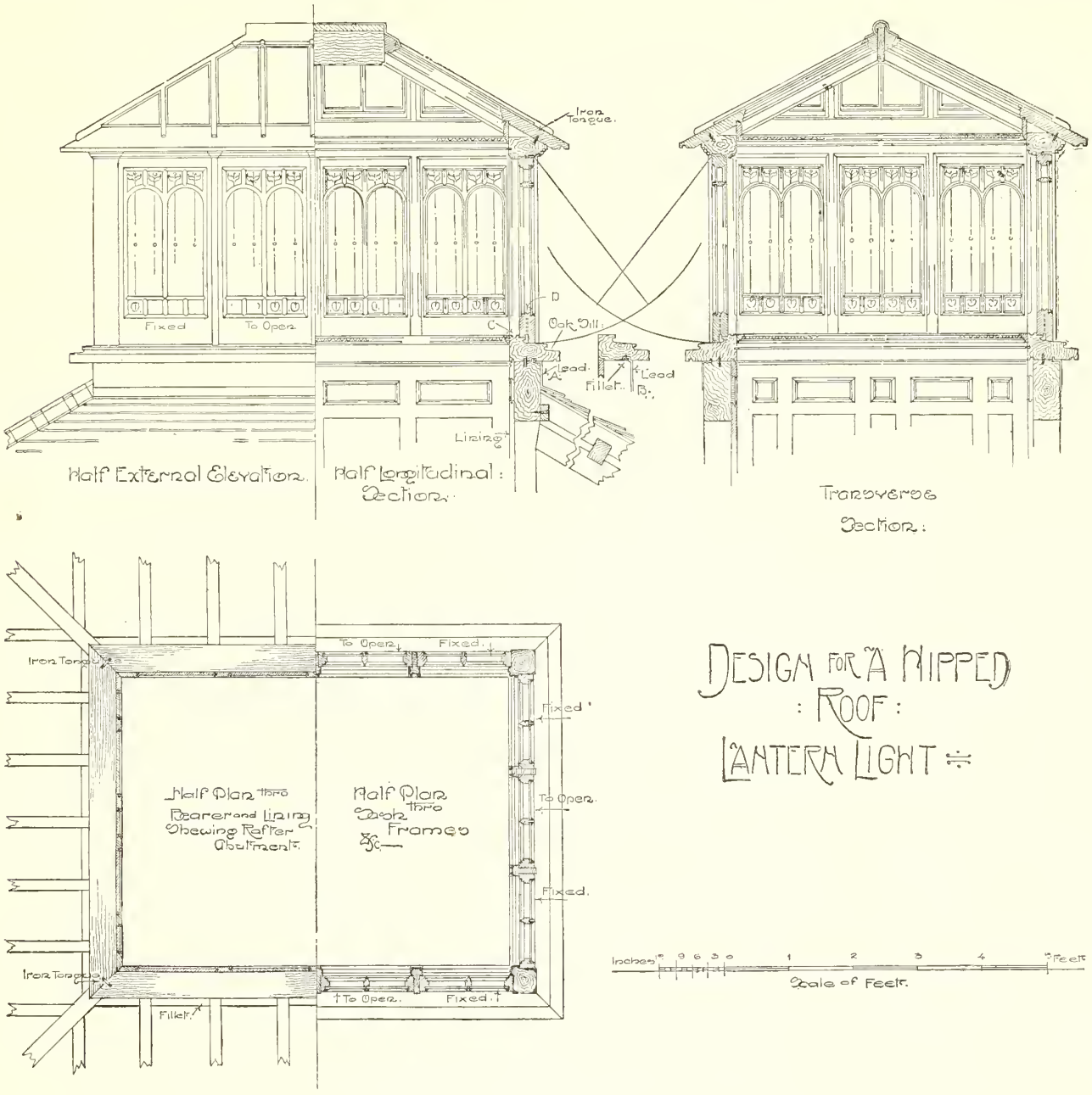


FIG. 141.

thickness of the lining or framing, so that the latter may be tongued into it and finish flush as shown. The sashes in the sides, when required to open, should be hung from the top and open outwards. As a considerable amount of condensation always takes place in a lantern light, sufficient means must be provided for its escape. A method sometimes adopted is shown at C. Here a groove is run in the top part of the sill, which is carried up to form a guard for the bottom rail of the sash, weep holes being bored from this groove to the throating of sill. In this case the water has to run over the bottom bar of the sash to find an outlet, and a better method, avoiding this and providing a direct outlet, is shown at D. Here a small groove is formed in the top of the bottom bar, immediately at the junction with the glass, and is connected with the throating of the bar by means of holes, as shown by the dotted lines. To prevent the possibility of the wood swelling and closing these

holes, they should be "bushed" by having a piece of brass tube fixed in each of the full depth of bar. The best form of roof for a rectangular lantern is that known as a hipped roof. The heads of the side frames form the plates to carry the rafters when any are fixed, but usually hip rafters are carried from the corner posts and are mitred into a ridge; and these support the sashes, which lap over and are tongued to the heads of the side lights as shown. These sashes are glazed in the same manner as those of a skylight, the glass being fixed in a groove on the top bar, overlapping the bottom bar, where a dishing is formed for the escape of condensation.

As a difficulty may be sometimes experienced in determining the lengths of hip rafters, the simplest method of obtaining these, together with the lengths of the sash bars, is here given in Fig. 142.

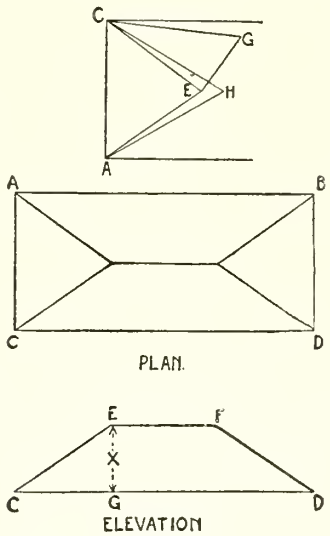


FIG. 142.

Let ABCD represent the plan of roof and CEFD the elevation. In neither case is the *true* length of the hip rafter indicated. Draw a plan of one end as shown by AEC. From E draw a line at right angles to EC, and mark off the distance on same to G, equal to the vertical height EG on elevation. CG is then the length required, and the isosceles triangle AHC, with AC as base and the length CG as sides, is the true shape of the end of the roof. Lines parallel to this triangle at the correct thickness will represent the sash framing, and the lengths of the sash bars may be found by setting out their positions along AC and drawing perpendiculars from them.

The method of obtaining the correct bevel of hip, or, as it is technically called, the *Backing*, may also be given. It is very necessary that these bevels be true, so that they may lie in the same planes as the sides and ends of the roof. Let BFD in Fig. 143 represent the plan of one end as before. Draw FK at right angles to FD, and in length equal to the vertical height between the top and bottom of the hip. Join KD, and from any point L erect a perpendicular to it cutting FD at M. From M draw a line at right

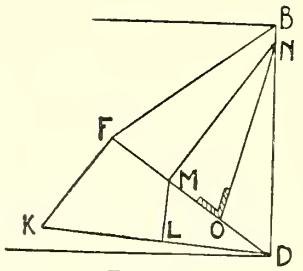


FIG. 143.

angles to FD, cutting BD at N. From M, with ML as radius, mark the point O; join NO, when the angle NOM will be the required bevel. The best method of ensuring water-tightness is to finish with a roll covered with lead and dressed down over the top bars of sashes, as shown in Fig. 141.

SHUTTERS.—The custom of fitting shutters to all windows is not so common now as formerly, especially in the case of the "Boxing," or more correctly "Folding," Shutters (see Fig. 144). These are constructed in two parts, each part covering half of the window, and consisting of two or more leaves, according to the space to be covered. The leaves are hung "folding,"—that is, turning back on each other,—the whole being hung to the window frame, and when not in use turning back into a recess. The outer leaf, or "shutter," is framed and filled in with moulded panels, and forms a splayed or square jamb lining to the windows, according to the design. The inner leaves are usually termed "Flaps." If not wide they may be formed of solid boards, mitre-

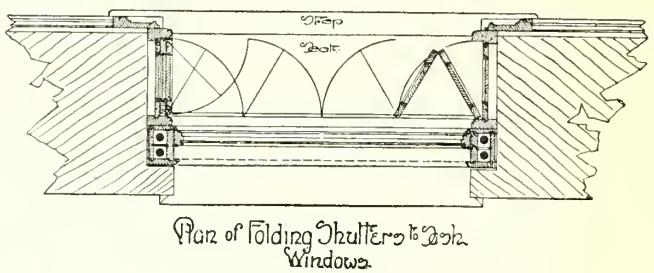


FIG. 144.

clamped to prevent casting; but if required of a greater width than from 8 to 9 inches, they should be framed. Where they are liable to be much used the side next to the room should have the panels moulded.

Another form is that known as "Lifting Shutters." These are hung with cords and counter-balancing weights similar to those of sashes in cased frames. They are framed and panelled, and if the windows are wide are fitted with rails, the panels being moulded. The frame is fixed inside the window frame, a space being left between the two for the blind. A space must also be provided below the window board to contain the shutters, the window board being hinged

so as to cover the shutters when not in use. A cover flap is usually hinged to the jamb, so as to close over and hide the hanging cords. The top of each shutter is fitted with a flush ring for the purpose of raising. The shutter next to the window, when closed, covers the top sash, and the other the lower sash, and the meeting rails when closed should overlap sufficiently to allow of their being fastened together with a thumb screw.

External Louvres, made in the form of sliding shutters, or, as they are sometimes called, *Venetian Shutters*, are used principally as sun blinds. They consist of two frames, each the full height of the window and half the width, carried in a guide frame extending the width of a shutter on each side of the window, so that the shutters may be pushed back quite clear of the light space. The shutters should be made of a frame of 1-inch stuff, 3 inches wide, dovetailed at the angles, and filled in with $\frac{1}{2}$-inch louvre boards, spaced so that the lower edge of one overlaps the upper edge of that beneath it, and housed $\frac{3}{8}$ of an inch into the sides. The bottom of each shutter should be fitted with a pair of brass pivot rollers, and $\frac{1}{4}$-inch play should be allowed in the guide frame, which should be made of teak or some other hard wood.

Jalousies.—Another form of external shutter is the French "jalousie," consisting of a wood frame with wood louvres. This is hinged at the side and attached to the window frame by specially constructed wrought-iron hinges. In England, where reveals are generally used, a large projecting hinge becomes necessary, so that the shutter can lie flat against the wall at the side (see Fig. 145, which is extracted from the *Building News*). Shutters such as these admit a considerable amount of light, though they shut out the direct sunshine, and allow a large amount of air to pass through. They are best suited to the casement window, but the sashes must open inwards. In Jersey, at anyrate, these "jalousies" are commonly employed with the sash window, and add largely to the comfort and appearance of the house. They fall back on either

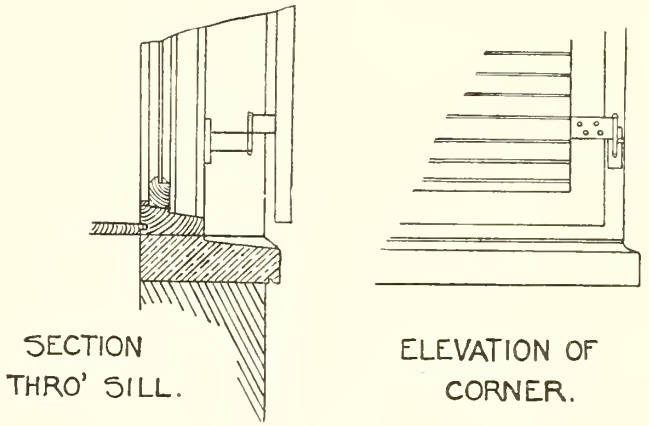


Fig. 145.

side when open, and, being usually painted green, give a pleasing effect to otherwise uninteresting exteriors. For this reason they have been introduced into English houses. Being simple things to make, they can easily be fixed on a house already erected, provided enough of the frame is exposed for attaching the hinges to, as any local joiner could make the shutters, and the hinges, although peculiar, can be made by any smith.

CHAPTER V

CUPBOARDS, AND BATH AND W.C. ENCLOSURES

(Contributed by H. Kennard)

Where it is desired to form a cupboard in a recess it is sometimes done by closing the opening with framing, in which a door is hung, either carried right up to the ceiling or stopped at a convenient height and covered with a top.

This is, however, not a method to be recommended, as it is much better to have the recess properly lined with boarding, matched or plain, secured to the wall, or a complete cupboard formed to fit the recess. In this case the back and sides would be formed of matchboarding, grooved, tongued, and either beaded or V-jointed; or of plain boarding, grooved and tongued together. The front should be framed, and hung with a single door if it be less than 3 feet in width, or with folding doors if more than that width. Fig. 146 shows the plan, elevation, and section of a cupboard of this description. The door is a four-panel one. Moulded outside, with panels flush on the inside, hung in framing consisting of side posts and head, which are tongued to side linings and top. If required for a hanging cupboard, hooks may be screwed to the lining; if with shelves, these are carried on bearers secured to the sides as shown. As it occasionally happens that more room is required than that provided between two shelves, it is a good plan to have the selves cut to exactly fit the opening but not secured, so that any of them may be temporarily removed if desired. A finish is provided by an architrave, which should match that round the room door, and be secured across the top by means of angle blocking.

On one of the bedroom floors there should be fixed a linen cupboard, and, if possible, it should be in close proximity to hot-air or hot-water pipes, so that its contents may be kept as dry as possible. If the hot-water cylinder or other means of warming be introduced into a lined cupboard, it must be well ventilated by means of holes near the bottom and top, so as to provide proper circulation of air and allow any steam arising from damp clothes to escape. If there be room, it is advisable that such a cupboard be provided with rails, on which clothes could be hung, these rails being made out of broom handles.

As a linen cupboard does not as a rule stand in a recess, one on both of its ends will be exposed. They must then be panelled to correspond with the front.

The general method of construction would be similar to that illustrated in Fig. 146, except that the framing should be stouter, out of 2-inch or $2\frac{1}{4}$-inch stuff, and

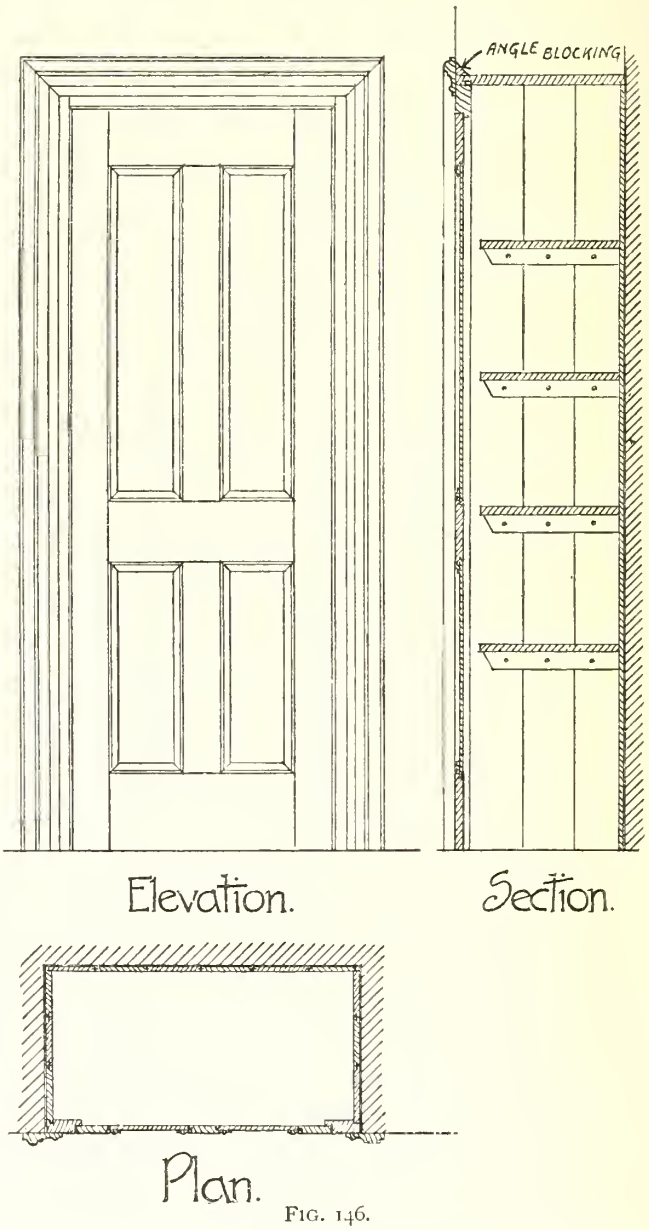


Fig. 146.

an independent floor should be fitted. It should be finished with a moulded plinth and cornice. The

corners should be bull-nosed and fitted as shown in Fig. 147. The quadrant corners of the cornice being

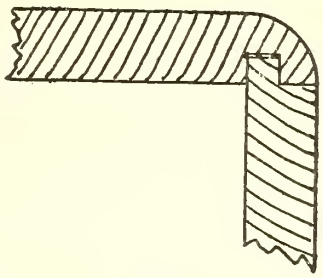


Fig. 147.

formed separately and butted, dowelled, and glued to straight lengths, as shown in Fig. 148.

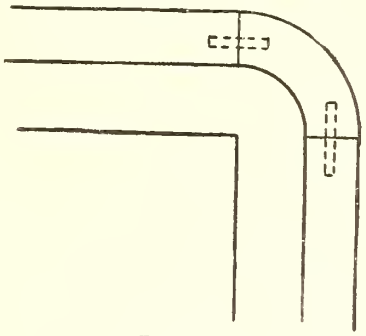


Fig. 148.

Dressers.—Fig. 149 shows a front and side elevation of a typical dresser, fitted complete with drawers, shelves, etc., and with a large open space beneath the former. A similar open space beneath the lowest shelf is not often provided, but when this is boxed it only forms a place for dust to collect in, which would probably never be swept away, and is also likely to

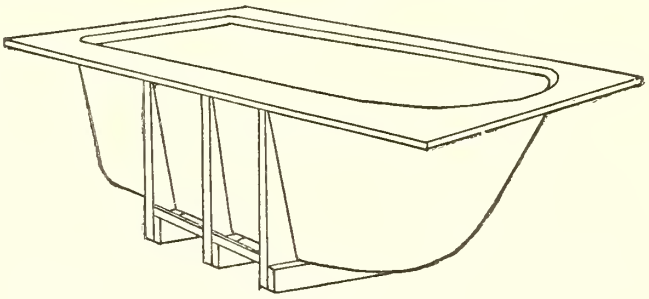


Fig. 150.

harbour vermin, etc. The detail at A shows the method of fixing the shelves by housing, while a small fascia bead spiked to the edge of each shelf and slightly deeper than the latter is provided to prevent plates from slipping off.

Bath Enclosures.—The number of improvements which have, during recent years, been introduced into the construction of baths and water-closet pans have

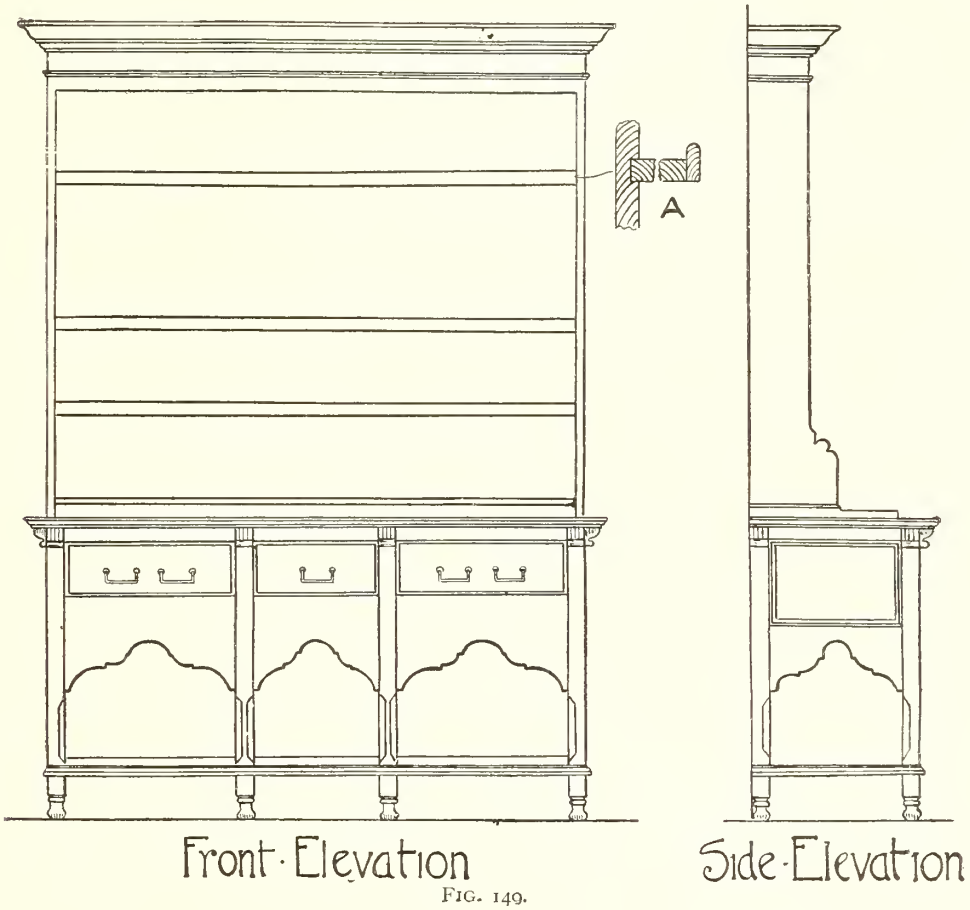
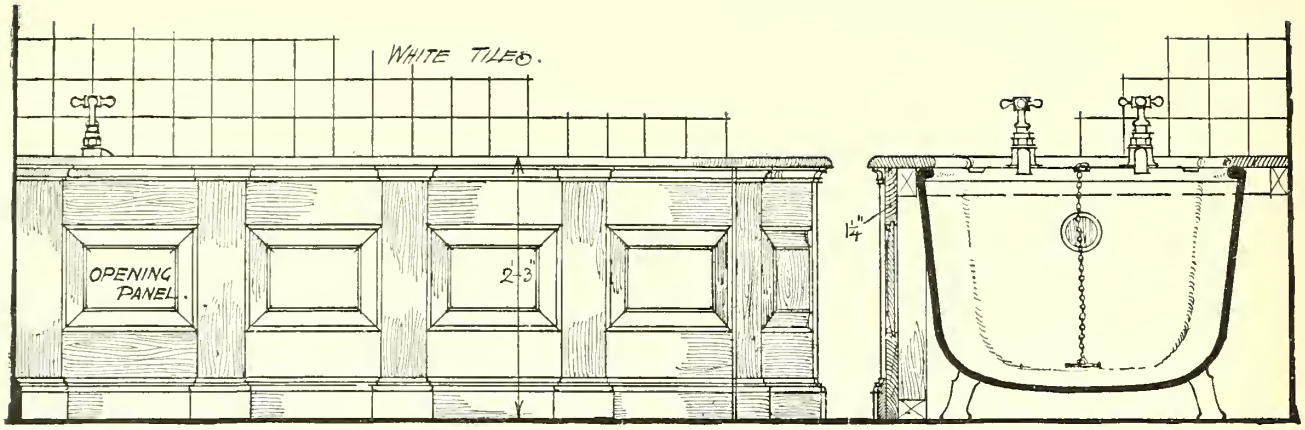
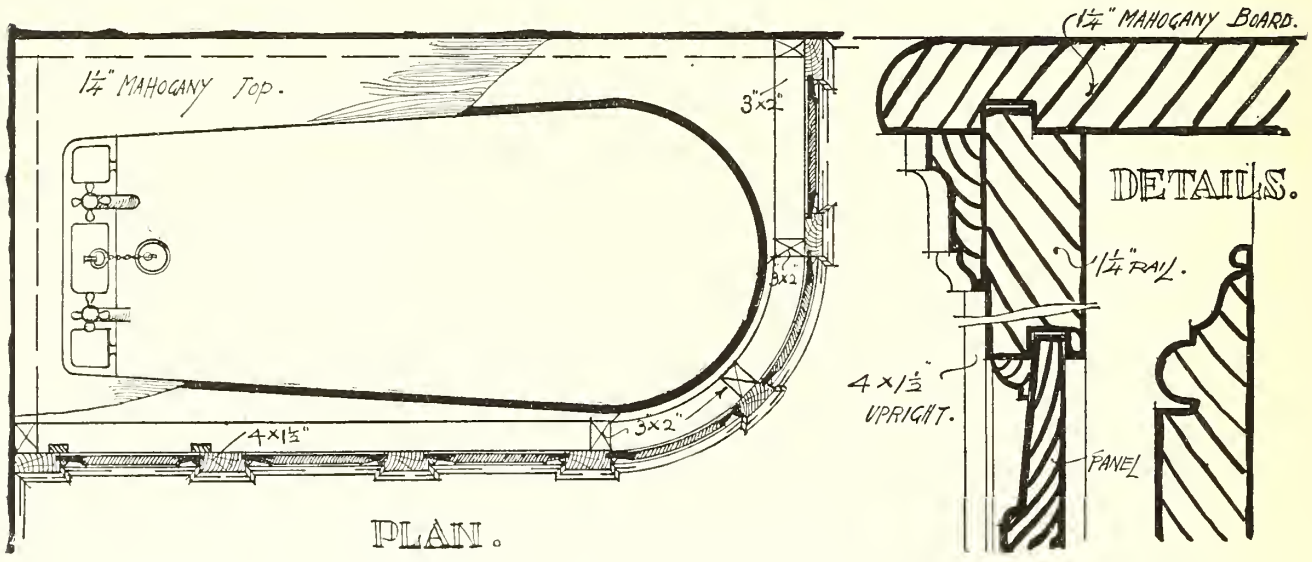


Fig. 149.

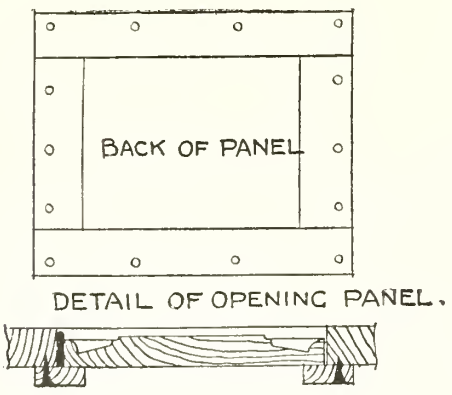


FRONT ELEVATION.

CROSS SECTION.



PLAN.



DETAIL OF OPENING PANEL.

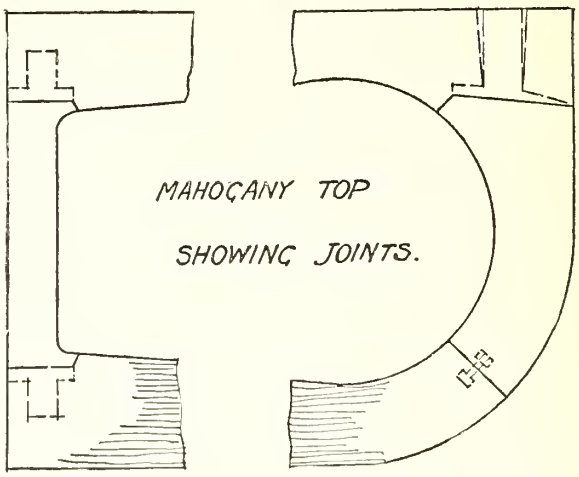


FIG. 151.

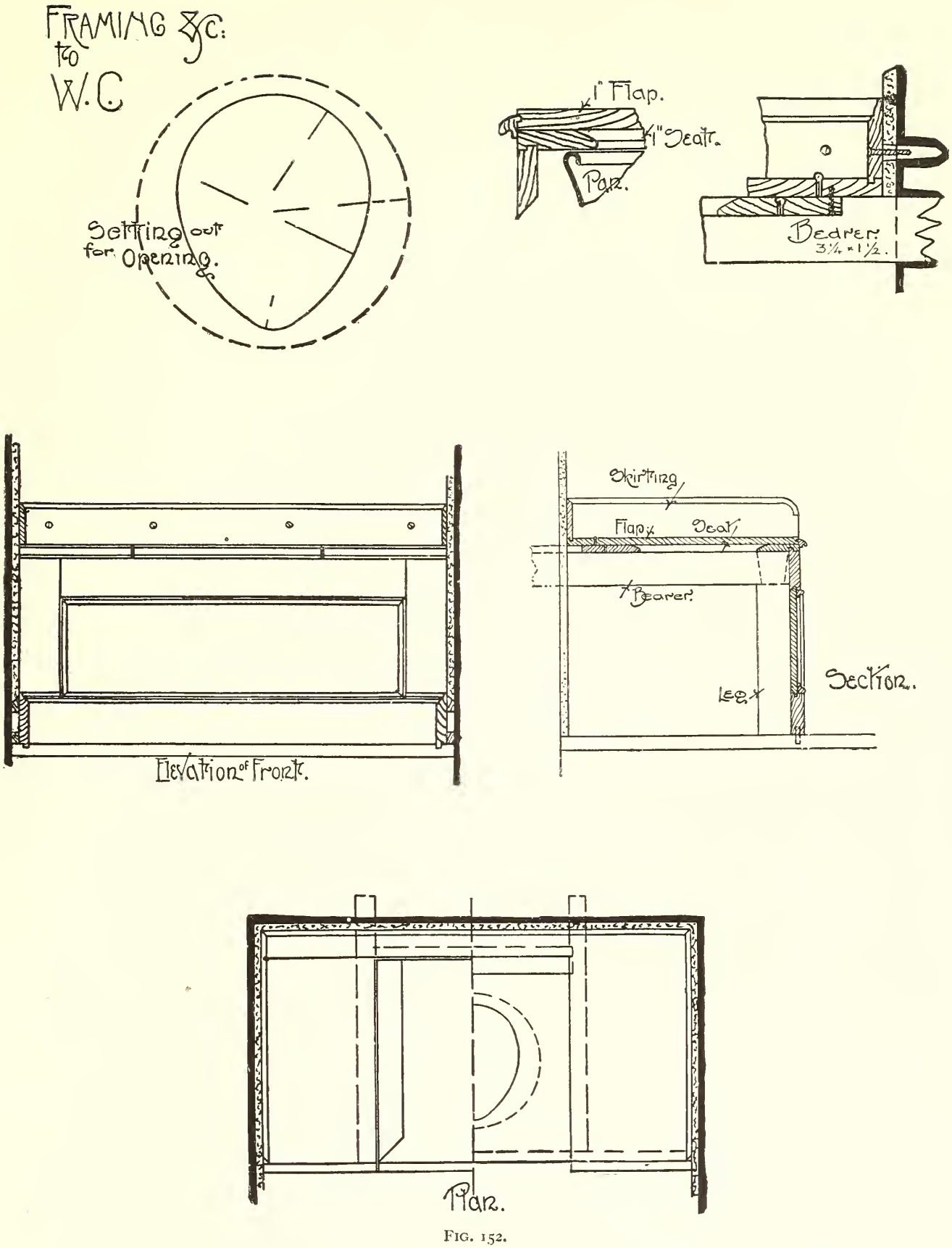

FRAMING &c:
to
W.C.
Setting out
for Opening.
1" Flap.
1" Seat.
Par.
Bearer
3½ × 1½.
Elevation of Front.
Skirting
Flap
Seat
Bearer
Leg
Section.
Plan.

FIG. 152.

to a great extent rendered enclosures unnecessary. Bath enclosures are, however, sometimes required, especially in the case of baths, to which *Cradling* has to be provided. Fig. 150 shows the cradling to a bath as it is usually constructed

Where the bath is enclosed it usually stands in a corner of the room, so that one side and end only require covering with woodwork, the top fitting into the angle of the walls and being finished along the side and end next to the walls by a narrow skirting.

The most suitable wood for bath enclosures is mahogany, although sometimes the top only is made of this, the enclosure being of deal, painted or stained. Fig. 151 shows an enclosure in plan, section, and elevation. The framing is $1\frac{1}{4}$ inch, and is usually moulded in the solid. The external angle is sometimes formed square, but in good class work it should be rounded as shown. The front only is then rounded, the back being straight across the angle. The joints in top and bottom rails are butted and fixed by means of hand-rail screws. The inside edge of top should be slightly sunk, and fitted closely to the bath with a red and white lead joint.

Means of access to the trap end of the bath should always be provided. This is sometimes done by hanging the end panel on butts, which is all very well for inspection; but when any work has to be done, such as fitting a new trap, it is generally found inadequate. It is much better to have the front made in two parts, so that the two end panels, with framing, may be entirely removed and refixed without damage. This may be accomplished by having a double munting in the centre.

If not cradled, the bath is carried on shaped wood bearers, a fillet being fixed to the wall to carry the top as shown, the outer edge being buttoned to the front. Fixing is provided by means of a fillet secured to the floor. Fig. 151 also shows the method of forming the top to the bath. The junction between the side and end of the top where the curved face occurs is formed by butting the two timbers and securing them by means of a hand-rail screw. The ends are fixed by fox-tail wedging or dovetail halving. The shoulders of the tenon joints are cut normal to the curve of the opening, so as to make a strong and neat joint to the rounded edges.

W.C. Enclosures are necessary with valve closets, but are now rarely used with any others. They are usually made to fill the entire space between the walls of the closet. The width is seldom great enough to necessitate ends.

The front or "riser" consists of a piece of rectangular framing filled in with one or two panels, usually only a single long one. The bottom rail is of extra thickness, and projects beyond the face to form plinth.

The seat is carried on two stout deal bearers wedged into wall at back, and dovetail tenoned to legs in front. These bearers are rebated to take the hanging rail, which is hung on brass butts let in flush with the surface. A hanging rail for flap is fixed on top of this, and must be set to such a position that the seat, when opened back on to the flap, lies quite flat upon it. A narrow skirting fixed round the wall and tongued into the top completes the fitting. Fig. 152 is a section showing the various parts and method of fitting.

The riser should not be fastened to the floor, but the bottom rail should be provided with two dowels

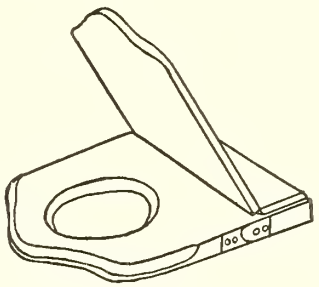


Fig. 153.

fitting into holes in the floor. The top rail is tongued into the seat. The flap is finished with a moulding tongued to the front edge, that known as the "treacle" mould, having a double lip, being generally used, as it provides a good grip for the fingers when closing.

The hole in the seat is cut oval in shape, and in setting out is struck from four different centres as shown in the plan. The dishing is carried from the oval to a circular finishing.

No w.c. enclosure should be so fixed that it cannot be easily removed for access to the closet valve and

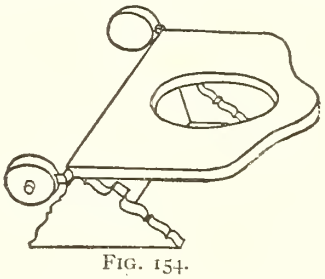


Fig. 154.

trap. A plan sometimes adopted, and one to be commended, is that of having grooved guides fixed to the wall, into which the riser slides complete, so that, when the flap and seat are raised, the riser can be lifted right out and as easily replaced.

The modern pedestal closet requires no woodwork beyond a small seat and flap, and frequently a seat only. Various patterns of these seats are made, the ordinary kind with flaps being shown in Fig. 153. Both flap and seat are hung on butts, so that the seat when raised enables the pan to be used as a urinal. Where, however, the closets are in such situations as to be frequently required as urinals, a special seat

without flap is fixed. This is shown in Fig. 154. It is fitted with a counter-balance weight, and so poised that, after use, the seat is very gradually raised by the action of the weight and turned back upon rubber stops. Rubber studs are inserted in the under side of all seats where they come in contact with the pan.

A useful addition to the fittings of a w.c. may be made in the form of a short hand-rail, placed within easy reach of the seat, so that it can be grasped and used by invalids or aged persons to enable them to rise. It may be made of hard wood to match the seat, or of brass carried on wood brackets.

A small box should also be fixed to the wall to contain toilet paper

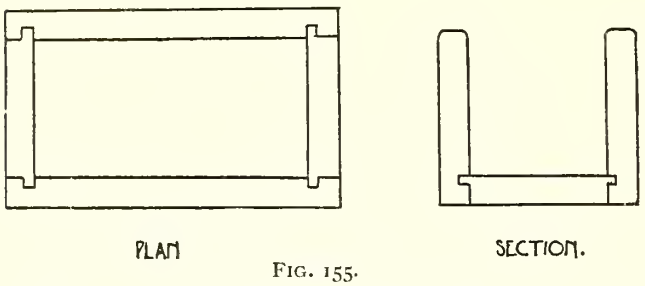


Fig. 155.

Housemaids' Sinks are frequently provided on bedroom floors to take all slop water, and are sometimes fixed in a recess and hidden by a door, giving the appearance of a small cupboard. When constructed of wood they should in all cases be lead lined.

Ordinary sinks made of wood are framed together, as shown in Fig. 155. $1\frac{3}{4}$ or 2-inch stuff is used, and the joints should be put together with "Beaumontique," which is a mixture of white lead, boiled oil, litharge, and a little whiting made to the consistency of a very thick paint.

All exposed water or gas pipes should be covered with *Pipe Casing*, which is made of $\frac{3}{4}$ or $\frac{7}{8}$-inch boards, either rebated or tongued, and nailed together in the form of a shallow trough. It should be fixed to wall plugs or fixing bricks by means of screws, either through the sides themselves or through screw plates fastened to them so as to be readily taken down when required.

The external angles should have a return bead worked on. Where a number of pipes have to be covered, necessitating wide casing, the sides are

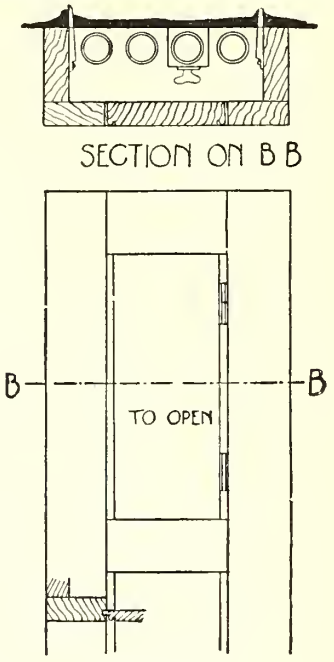


Fig. 156.

secured to the wall by means of holdfasts, as shown in Fig. 156. The front is separate, framed and panelled, and fixed to the sides with screws having cups.

In positions where taps occur ready means of access must be provided. This is best accomplished by arranging a panel to come immediately over the taps, and hanging it on butts, fastening it with a small cupboard lock.

CHAPTER VI

STAIRS AND STAIR-BUILDING

(*Contributed by H. Kennard*)

The setting out and constructing of stairs, including all requisite hand-railing, is one of the highest branches of Joinery, if not the highest. It embraces work far beyond the scope of the ordinary joiner, necessitating a course of special training. For this reason there are in all joinery works special men, known as "Staircase hands," who are kept almost exclusively for stair-building work. One of the indispensable qualifications of a staircase hand is that he be able to intelligently read drawings. He may be also called upon to make his own working drawings, which will entail a knowledge of drawing instruments and their use; and he must be capable of so illustrating his ideas on paper that others besides himself may readily grasp his meaning. This is not an easy thing to do, especially in staircase work.

The following is a Glossary of some of the technical terms used in stair-building and hand-railing:—

Staircase.—The whole system, including all flights.

Flight.—A complete length of treads and risers, reaching from floor to floor, or from floor to landing.

Tread.—The horizontal board upon which one treads when going up or down stairs (Fig. 161).

Riser.—The vertical board rising from the back of one tread to the front of the next above (Fig. 161).

Landing.—A level space at the top of a flight, and between floors, usually where the direction of stairs changes.

Quarter-space Landing.—A space equal to the width of one flight, extending half-way across the well (Figs. 157 and 159).

Half-space Landing.—Equal to the width of two flights, extending right across the well.

Well, or *Well Hole.*—The space from top to bottom of a building containing the staircase. In the case of "Dog-leg" Stairs this is completely filled. With "Open newel," "Circular," and "Geometrical" Stairs a space is left between the two outside strings (Figs. 158, 159, and 166).

Step.—When the tread and riser are framed together the combination is termed a "Step."

Strings.—The sides of stairs carrying steps. When they rise above the steps, completely enclosing their ends, they are called "Close" or "Housed" Strings. (Fig. 166). A "Cut" or "Open" String, on the other hand, is shaped to fit underneath the steps, which have their ends returned across its face (Fig. 159). A cut and mitred and bracketed string is cut to mitre with the riser, and has thin, ornamental shaped brackets fitted to cover the ends of risers (Fig. 167). When the plan of a string forms part of an ellipse or circle, while at the same time it rises with the pitch of stairs, it is termed a "Wreathed" String. The two strings to one flight are named "Outside" or "Outer" String and "Wall" String, according to their position, the names being self-explanatory.

Pitch of Stairs.—The angle formed between the floor and the line of nosings.

Nosing.—The rounded edge of tread which projects over the riser (Fig. 161).

Line of Nosings.—An imaginary line drawn from the nosing of top step to nosing of bottom step of a straight flight. All nosings in the flight should just touch this line.

Scotia.—A small hollow moulding fitted into the angle between tread and riser immediately under the nosing (Fig. 161).

Pitch Board.—A thin triangular piece of wood the sides of which represent respectively the "Rise," "Going," and "Pitch" of step.

Rise of Step.—The vertical height from top of one tread to top of next (Fig. 161).

Rise of Stairs.—The vertical height from one floor to the next.

Going of Step.—The horizontal distance between the face of one riser and the face of next (Fig. 161).

Going of Stairs.—The horizontal distance between the face of the bottom riser and the face of top riser in the same flight.

Bull-Nose Step.—One having a rounded end. The usual formation of the bottom step of the stairs (Figs. 157 and 166).

Margin.—The projection of a close string above the nosings of the steps (Fig. 166).

Capping.—Moulding planted on the top edges of close strings (Fig. 166).

Drop.—The ornamental end of newel post projecting below string (Fig. 166).

Rough String.—A board fixed inside a cut string to strengthen it, and notched to fit the steps.

Wreath Piece.—The portion of string immediately under the hand-rail wreath (C, Fig. 159 and Fig. 168).

Winder.—A step in a turn of stairs tapering in width from wall to outer string or newel. The one coming in the angle of walls is termed a "Kite" Winder (Fig. 157).

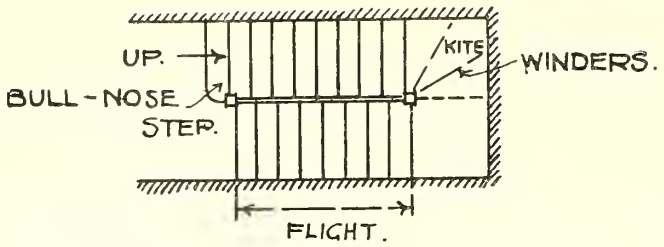


Fig. 157.

Flyers.—Ordinary flyers are the parallel steps in one flight. "Diminished" flyers come next to the winders, and are slightly reduced at one end (E, Fig. 158).

Dancing, or *Balanced Steps*, are winders not radiating from a common centre.

Curtail Step.—One having a spiral end (Fig. 159).

Commode Step.—One having its front curved on plan (Fig. 165).

Planceer.—The under surface of a flight of stairs, as distinguished from

Soffit.—The finished boarding or plaster under stairs (Fig. 166).

Carriages. — Pieces of stout timber fitted up the under side of steps for support (Fig. 166), and providing a fixing for the soffit.

Pitching Piece.—A piece of timber fixed under stairs between newel and wall (Fig. 166), into which the carriage is framed.

Bearers.—Short pieces fixed to support winders.

Spandrel.—The space between floor and under side of string (Fig. 166).

Apron Piece.—A thin deal facing to the trimmer of landing (Fig. 166).

Newels.—The posts at top and bottom of a flight, into which hand-rail is fixed (Figs. 158 and 166).

Ballusters.—Vertical pieces fixed between hand-rail and string, or hand-rail and treads, as the case may be.

Hand-rail. — The moulded rail fixed on top of ballusters, with them completing the ballustrade, and forming a protection at the edges of steps and landings.

Ramp.—A short upward curve in a straight length of hand-rail (A, Fig. 170).

Knee.—A short forward curve, the reverse of a ramp (B, Fig. 170).

Swanneck.—A combination of the two foregoing curves (Fig. 170).

Turn.—A horizontal curve in a hand-rail.

Wreath.—A twisted curve, in which the hand-rail, while being curved on plan, rises at the same time with the stairs.

Mopstick Hand-rail.—A hand-rail round in section, except on the under side, which is flat.

Monkey Tail.—A hand-rail finished with a vertical scroll.

Scroll Cap.—The same finish fixed horizontally (Fig. 159).

Mitre Cap.—A moulded circular cap fixed on top of a newel, to which the hand-rail is mitred.

Core.—A thin flat bar of iron sunk into the under side of hand-rail.

Nosing Line, which must not be confounded with "Line of Nosings," is a line drawn upon the string for the purpose of setting out the steps thereon (Fig. 160).

Staircases are of several kinds, and the names given to them are based upon the appearance of the stairs in plan, or upon the way in which their strings are constructed.

In houses where the floor area is limited the stairs are generally compressed into the smallest possible space, and not infrequently very awkwardly placed. The staircase best adapted to small buildings is that known as *Dog-leg* Stairs. This style is shown in

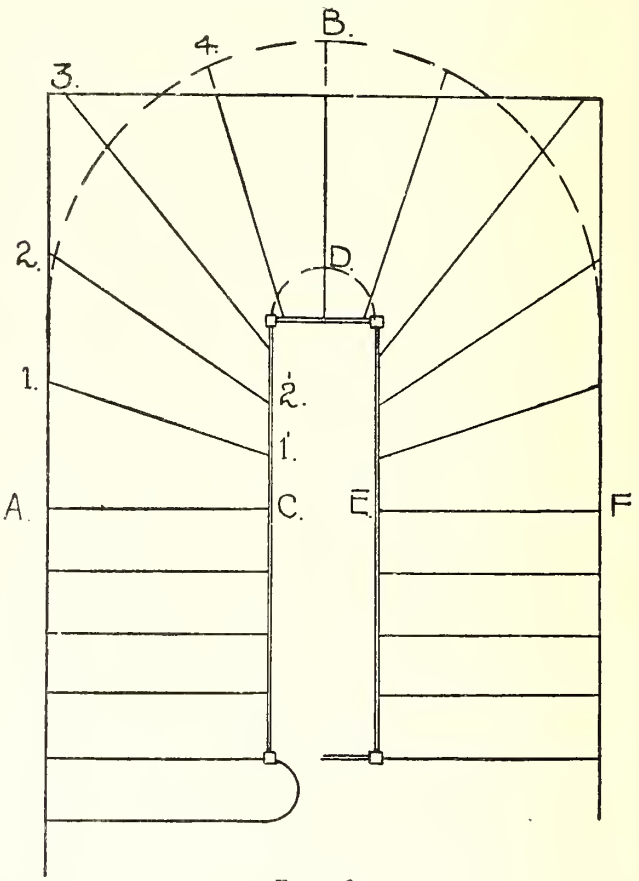


Fig. 158.

Fig. 157, its not altogether euphemistic name being derived from the supposed similarity borne by the string in elevation to the hind leg of a dog. In the illustration some winders are shown in dotted lines, but where it is possible to obtain sufficient "going" it is much better to have two straight flights and a half-space landing. Winders are a frequent cause of

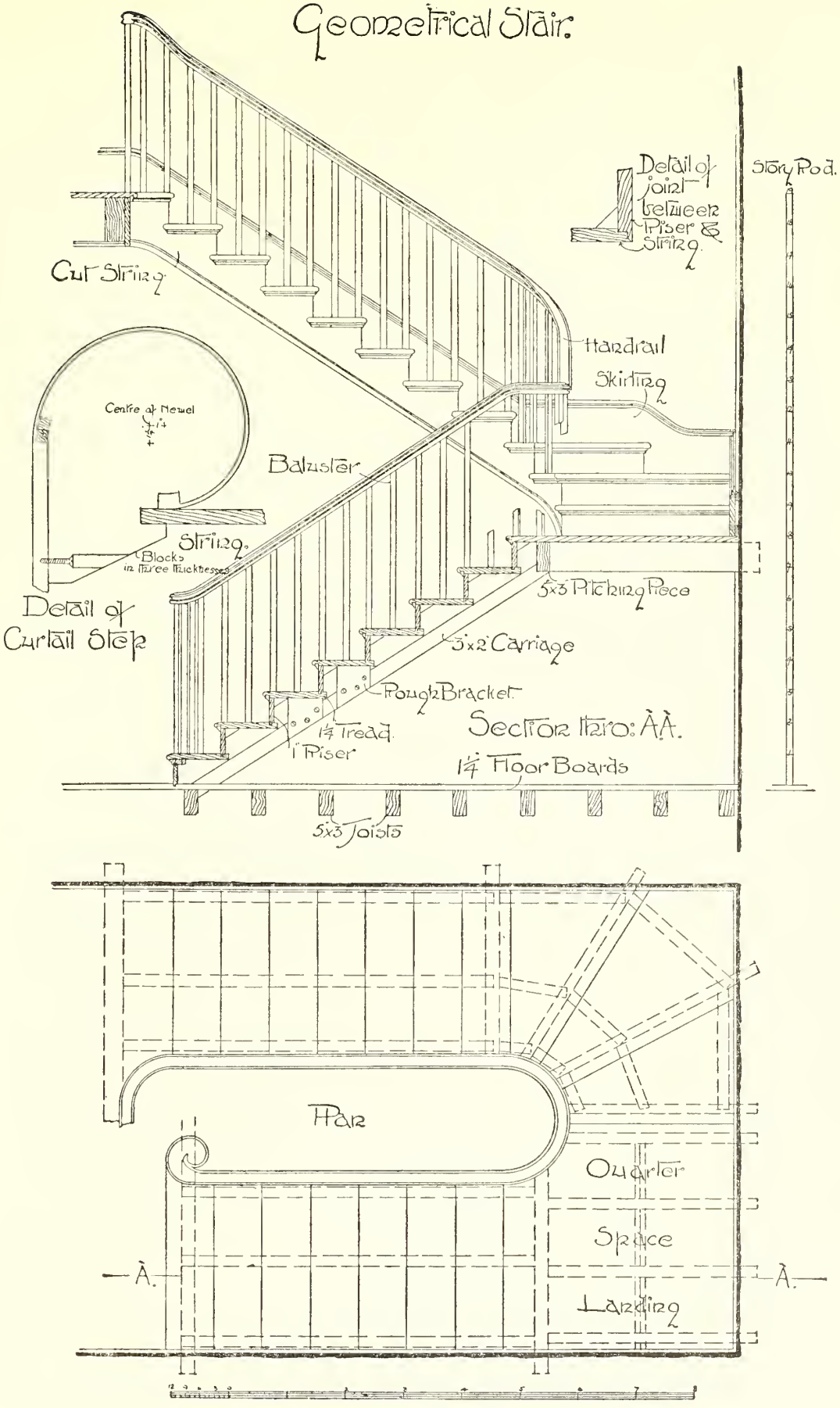

Geometrical Stair.
Detail of joint between Riser & String.
Story Rod.
Cut String
Handrail
Skirting
Centre of Newel
Baluster
String.
Block in three thicknesses
Detail of Curtail Step
5x3 Pitching Piece
5x2 Carriage
Rough Bracket
Section thro: AA.
1¼ Tread.
1" Riser
1¼ Floor Boards
5x3 Joists
Plan
Quarter
Space
Landing
A.
A.
Scale

FIG. 159.

accident, owing to the diminished tread, and should not be used except in unavoidable cases, and should also be placed at the bottom in preference to the top of a flight; that is as in Fig. 159, and not as shown in Fig. 157, although there is great diversity of opinion on this point.

To avoid dangerous winders, stairs are sometimes treated as shown in Fig. 158, where it will be noticed that flyers are carried up as far as AC, when two semicircles are struck tangentially to the outer and inner strings. The distances AB and CD and ABF and CDE are divided into any convenient number of parts at the points 1, 2, 3, and 4, when by joining 1, 1, 2, 2, etc., the outlines of the stairs are found.

Where sufficient space is obtainable the *Open Newel* is undoubtedly the best style of staircase. Fig. 166 is an example of this kind, but they may be better arranged with frequent landings, often between two straight flights as well as at changes of direction, thus making them easier and less fatiguing to mount. This is the style usually adopted in large houses, when they are frequently of massive construction and elaborately decorated.

Another kind of staircase is that known as *Geometrical*, on account of the plan assuming a geometrical form, and the setting out requiring the application of geometrical principles. One example of this kind is shown in Fig. 159. The essential difference between these stairs and those previously described lies in the fact that dog-leg and open newel are dependent upon the use of newels for their construction, whereas with geometrical stairs no newels are required. They may occasionally be inserted by way of extra ornamentation, but that is all. In the case shown in Fig. 159 the plan of string at the ends of the well hole is semicircular, and the string is continuous from top to bottom. Quarter-space landings are sometimes introduced, but more frequently winders are carried right round. Better foothold can be given on these winders than in the case of newel stairs, as the treads do not require so much diminishing. Winders are set out in all cases on what is known as the *Walking Line*. This is an imaginary line drawn parallel to the centre line of the hand-rail, and 18 inches from it. Winders should not be set out so that the riser comes in the angle between walls, as they are more difficult to construct there, and not so satisfactory as "kite" winders, which are shown in Figs. 157 and 159, and are much better. To accomplish this, an odd number of winders must be arranged in each quarter space. The tread of a winder at the walking line may exceed but must never be less than that of the flyers, and it will be found in practice that most ordinary cases will be met by three winders for the quarter and six for the half turn, especially where diminished flyers and dancing steps are used. Under the same heading may be placed *Circular* stairs, which consist of a well hole circular on plan, and consequently having all the steps winders. The outer string may be also circular, but it is more often square or octagonal. "Spiral" stairs or "circular newel" stairs, as they are sometimes called, are similar. These are also constructed of all winders, radiating from a centre newel to which they are all framed. They are seldom built of wood, however.

Although no fixed rule can be laid down for the building of any of the foregoing staircases, each having to be treated according to the exigencies of the case, there are numerous details of construction applicable and common to all.

Before a staircase can be set out the requisite particulars must be obtained from the actual building. For this purpose a "Story rod" is used, which is a light rod about $1\frac{1}{4}$ or $1\frac{1}{2}$ inch square, and long enough to reach from floor to floor. As the rise of stairs between floors often varies, a separate story rod for each floor should be used, each being carefully indicated. In taking the dimensions the rod is placed against a joist in the upper floor in the well, or "stairway" as it is sometimes called, and, being "plumb" on to the floor beneath, a mark is made on it at the level of the upper floor. This should be marked *up*, and gives the rise. The going is obtained by placing the end of the rod against the wall and marking the distance to the joist or landing trimmer, as the case may be. Notes should be made of any doors or windows close to the staircase. The rod is afterwards divided with compasses into the number of steps required. There will always be one more riser than treads in a flight, the landing forming the tread to the last riser.

Various rules have been laid down for determining the rise and going of steps, with the object of securing each of the correct proportions. They are governed by the theory that the energy required for climbing is twice that required for travelling on the level. The average stride is taken as 24 inches, and the most general rule therefore states that rise × 2 + going = 24. This gives $6\frac{1}{2}$-inch risers for 11-inch treads, although

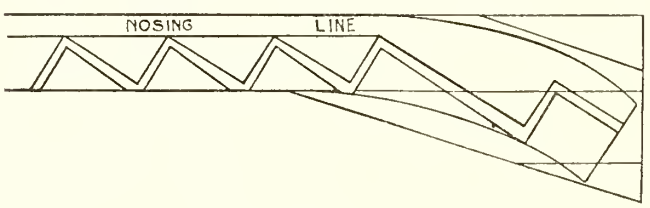


FIG. 160.

frequently in practice 6 inches and 11 inches are used, giving an easy-going stair. Where the rise is increased the going must be proportionately reduced, but it is not advisable to exceed $7\frac{1}{2}$ inches for rise or 12 inches for going,—of course, in each case maintaining the above proportion.

When the rise and going of stairs has been determined a pitch board is cut, and with this the strings are set out. In the case of a string where

there are winders, one board is seldom of sufficient width at the part where winders occur. It is then widened in the manner shown in Fig. 160, in order to cut the "easing" of the string. The pieces are groove-and-tongue jointed on. The "Nosing line" being marked on at the required depth of the margin, a thin strip of wood having a straight edge is temporarily tacked to this line, and along this the pitch board is run, the steps being marked with a

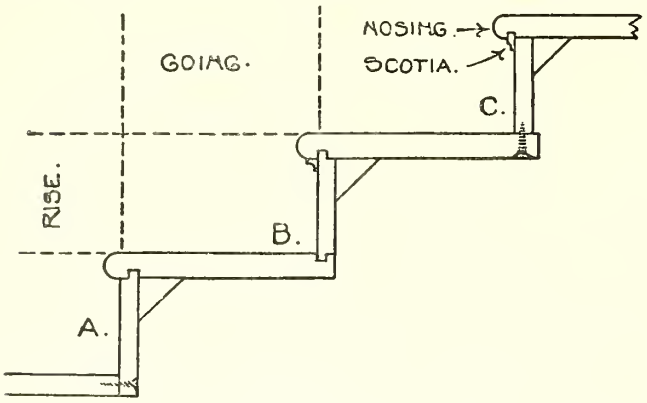


Fig. 161.

knife cut. The housings are marked at the same time by means of small wedge-shaped templates.

The several ways of connecting up the steps are shown in Fig. 161. That shown at A is the wrong method of tonguing the riser into the tread above. B is the correct method *when* they are tongued, and C the usual method. In this the riser is not tongued, the scotia is grooved into the tread, and the riser fits into the angle. The projection of the nosing is usually equal to the thickness of tread. The method, of fixing the bottom of riser to tread shown at A is

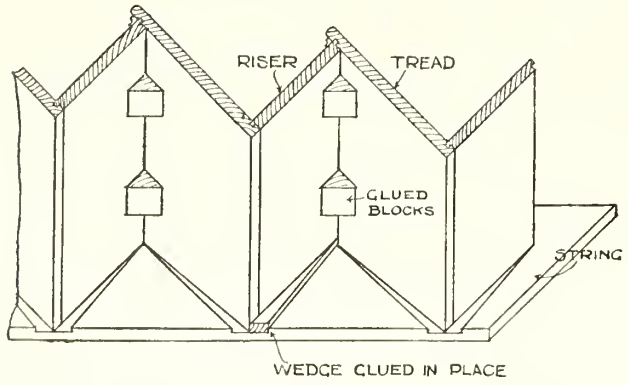


Fig. 162.

bad. It is sometimes used in common work to save jointing treads. B is the usual and correct method, and C is an excellent way preferred by many. Here the tread is screwed to the riser, which it slightly overhangs, slots being made for the screws, so that in case of shrinkage a little movement may take place without starting any joints. Small angle blocks are glued as shown in the angle between the tread and riser, spaced a few inches apart.

Steps are built up on what is called a "Cradle," which is really a guide, to enable them to be turned out square and true. The tread is placed on the cradle, the small strip which is to form the scotia is glued and fixed in the groove in tread, the riser is glued and pressed up against the strip, the angle blocks then glued behind, and, when sufficiently set to handle carefully, the steps are stacked on an even surface to dry. The nosings and scotias are worked afterwards.

Fig. 162 is a sketch of a small portion of the Planceer looking upwards, showing the housings in string, and the method of wedging the steps in same. The wedges

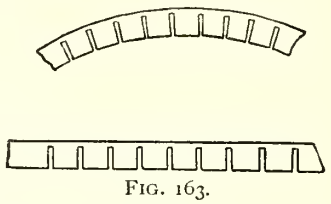


Fig. 163.

are shown dotted, and are generally wider than the depth of housing and project slightly above the string.

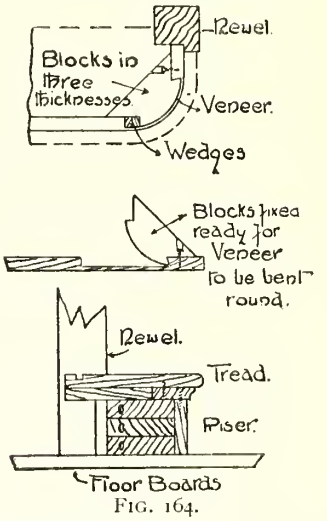


Fig. 164.

Housings are made from $\frac{3}{8}$ to $\frac{1}{2}$ inch in depth, and allowance must be made in the length of steps for

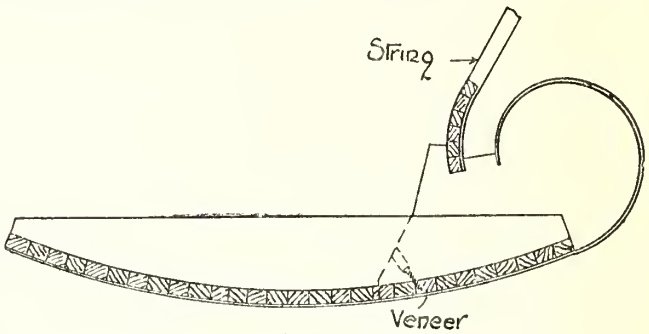


Fig. 165.

twice the housing in addition to the nett width of stairs. It is usual to construct the bottom step of stairs with

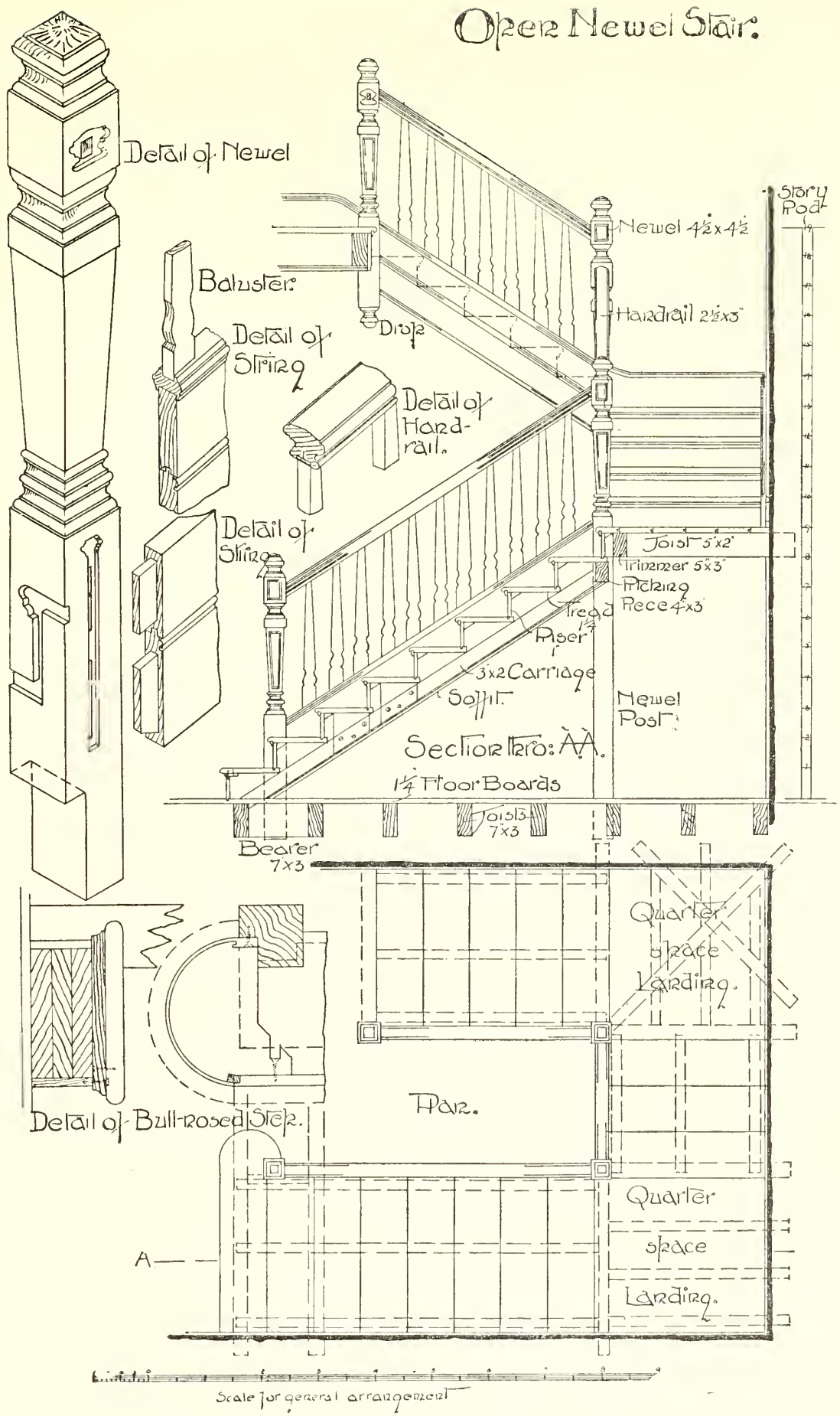

Open Newel Stair.
Detail of Newel
Baluster.
Detail of String
Detail of Hand-rail.
Detail of String
Drop
Newel 4½x4½
Hand-rail 2½x3
Story Rod
Joist 5x2
Trimmer 5x3
Pitching Piece 4x3
Tread
Riser
3x2 Carriage
Soffit
Newel Post
Section thro: AA.
1¼ Floor Boards
Joists 7x3
Bearer 7x3
Quarter space Landing.
Par.
Quarter space Landing.
A
Detail of Bull-nosed Step.
Scale for general arrangement

FIG. 166.

some ornamental finish, in the shape of either bull-nose or curtail ends or commode front. Frequently a combination of the two latter is adopted, and also the first few steps of the flight, in addition to the bottom one, may be formed with commode fronts, especially in the case of a shop or public building, where the lower portion of the flight stands independently.

There are two methods of forming a bull-nose end to a step, one wrong and the other right. The former is always adopted in common work, but is seldom practised by any self-respecting joiner. It is shown in Fig. 163, and consists in making a number of saw cuts or "kerfs," as they are technically called, across the riser to within about $\frac{1}{8}$ of an inch of the face and then bending the riser as required. The kerfs are exaggerated in the illustration to show the principle. An easy or quick sweep can be made in this way by putting few or many kerfs, but it can be readily seen that a true curve is not obtained, but merely a number of narrow straight faces.

The proper method is shown in Fig. 164. In this case a foundation for the curve is made by building up a block of several pieces to the required thickness, glueing and screwing them together and shaping as shown in plan, one notch, that nearest the newel, being undercut. The riser is then marked from this, and the back cut out leaving a veneer face, a little extra being allowed for wedges. When ready, the veneer is well wetted with boiling water, glued, bent round the block and wedged with folding wedges, the ends of the block being subsequently screwed to riser.

A curtail step is formed in much the same way, a block being prepared to the proper curve, and the riser veneered and bent round as shown in Fig. 165. When the lower portion of a string is also curved it should be treated as shown.

Commode steps are sometimes formed by kerfing the whole riser, and bending it to the sweep required, but this merits the same remarks as those applied to the similar manner of forming bull-nose ends. The correct way is shown in Fig. 165, and consists in cutting two ribs struck from the same centre as the required curve, but with $1\frac{1}{4}$ inch less radius, and nailing on narrow pieces of 1 inch stuff after the manner of a close lagged centre. The curve is then worked true and the front veneered on.

Open Newel Stair.—Fig. 166 shows a sectional elevation of an open newel staircase, consisting of three short flights and two quarter-space landings. Reference is made to the various parts illustrated in the Glossary at the beginning of this chapter. It is shown with "close" string and capping into which the ballusters are fixed. The second newel is carried to the ground, and the third may also be similarly treated if desired, and used as posts for the spandrel framing. The wall string is joined into the skirting on the top landing.

Geometrical Stair.—Fig. 159 shows the method of constructing a geometrical stair consisting of two flights, with a quarter landing at the head of the first flight, and the second flight commencing with three winders.

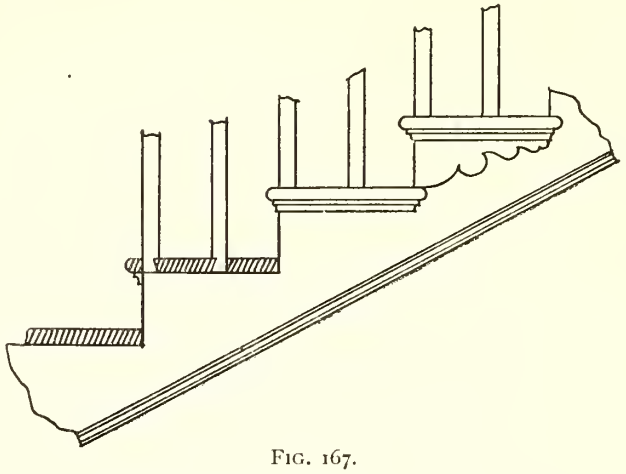


Fig. 167.

A portion of a *Cut* or *Open* string is shown in Fig. 167. The ballusters are here dovetailed into the treads, the nosing being afterwards returned along the end, either by means of groove-and-tongue joints or by secret screws. When brackets are not employed the risers are fixed to the string with a rebate and mitre joint, but when brackets are used they are mitred to the risers.

Ballusters may be either square or turned, in either case the ends being left square for fixing. With cut strings they are usually spaced two to each step; and with close strings, where they are fixed to the capping, they should be spaced from 4 to 5 inches apart. They are sometimes made from flat pieces about 4 inches wide by $\frac{3}{4}$ or 1 inch thick with shaped edges. They are either tenoned into the hand-rail or screwed to an iron core which is fitted into a groove in the under side of hand-rail.

The curved portions of outer strings in geometrical stairs, which occur at landings and winders, are termed *Wreath Pieces*. They are constructed separately, and joined to the straight lengths of string by means of a connection known as the "counter wedge key," or "counter cramp" (see "Joints"). To form the wreath piece, it is necessary to obtain the exact curve on plan and prepare a cylinder, or as it is sometimes called a "Dolly," to this curve. The cylinder is built on two ribs, narrow battens being nailed thereon and afterwards worked true. The piece of string to be bent is marked on the back between the springings of curve, and the back cut out to a veneer face. It is then well wetted with boiling water, bent round the cylinder, and secured as shown in Fig. 168. When in this position it is backed with narrow strips of wood glued and fitted tightly round, the whole being covered with a strip of coarse canvas glued on, which is not

shown in the sketch. Another method of forming the wreath piece, and one frequently used, especially in hard-wood strings, is that of using veneer for the whole piece. In this case the ends beyond the springings are backed with strips glued on parallel to the grain of the veneer, and known as "Tangent Backings." The wreath is then completed in the manner before described.

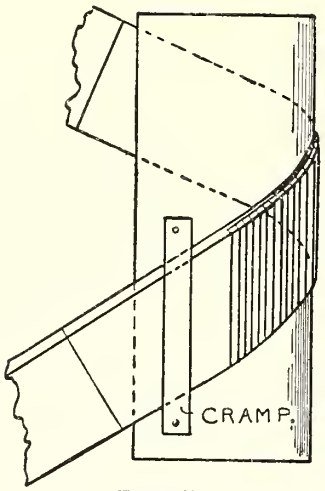


Fig. 168.

Stairs should in all cases be fitted with *Carriages*, one up the middle and one near each side. These are pieces of timber, of stout scantling, which perform the dual office of supporting the stairs and providing a fixing for the soffit. The two outside carriages must, of course, be the same depth as the middle one, but they need not necessarily be so thick. The position is shown in Fig. 166. Stairs fitted with light, springy carriages, or with no carriages at all (as is often the case in "jerry" work), are usually of the genus "creaky." Carriage brackets are in many cases added in order to obtain greater rigidity. They may consist

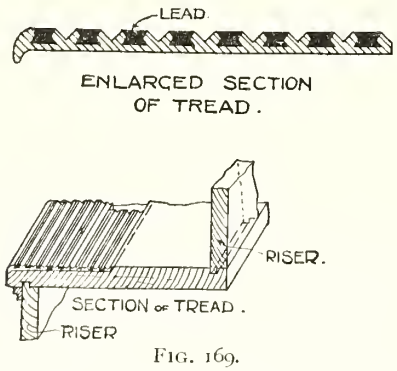


Fig. 169.

of triangular pieces, marked from the pitch board and fitted between the carriage and under side of tread, or pieces may be screwed to the side of carriage, fitting tightly up to tread, the lower edge being cut off to the same pitch as the carriage. In this case the weight is transferred to the carriage by means of the screws, the former method being more satisfactory and also more economical.

Owing to accidents having been caused by people slipping on stairs, various devices have, during recent years, been placed upon the market with the object of preventing this, most of which, while they are primarily designed for iron or stone steps, are equally applicable to those of wood. All staircases where there is much traffic should have the treads fitted with a non-slipping attachment. One of the best and most satisfactory is that shown in Fig. 169; it is the patent of the Safety Tread Syndicate Ltd., and consists of a steel or delta metal plate, dovetail grooved as shown, the grooves being filled with lead. The exposed surface of the steel is reduced to a minimum by the V-grooves, while at the same time sufficient is left to prevent the lead from wearing away. An enlarged section is given, and also a portion of a tread illustrating the method of fixing, the tread being sunk to receive the plate.

The general arrangement of stairs in a building should be such as to ensure ample light to all parts, especially turns and landings, while windows should be kept quite clear of strings. Another important point to be considered is that while as much as possible of the stairs should be put together in the shop, care must be taken that no larger portions are constructed than will readily go into position. For this reason, unless there be plenty of room, winders are as a rule fitted in the building. The width of stairs is in the majority of cases governed by circumstances, but where possible 3 feet between strings should be regarded as a minimum. The width should allow of two people passing easily.

Doorways should be kept well clear of landings both at top and bottom, and no intermediate landings should be separated by less than three steps. Odd steps in unexpected places are a source of danger. Where a landing is arranged between two flights in the same straight line its "going" must not be less than the width of the stairs.

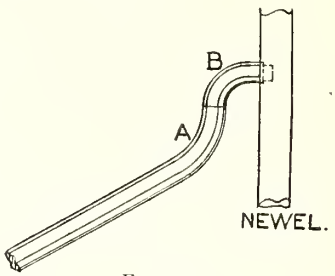


Fig. 170.

Hand-railing is the term applied to the work of forming and fitting hand-rails to stairs. In the case of Dog-leg and Open-newel stairs there is not much of a difficult nature to overcome, as the lengths are generally straight between the newels, any curves which occur being vertical and having their centre

lines on plan coincident with the centre line of hand-rail. These curves are shown in Fig. 170, which illustrates a "Ramp" at A, and a "Knee" at B, a combination of these two being known as a "Swan-neck." Where the hand-rail is not fixed into the newel at the commencement of stairs, as shown in Fig. 166, it is usually carried over the top of the newel by means of a ramp, and finished with a cap, either plain or carved, or with a scroll. These various curves and parts may be easily set out and worked from the solid.

It is when hand-rails have to be fitted to geometrical stairs that difficulties commence. There are several methods extant for obtaining the desired end, but

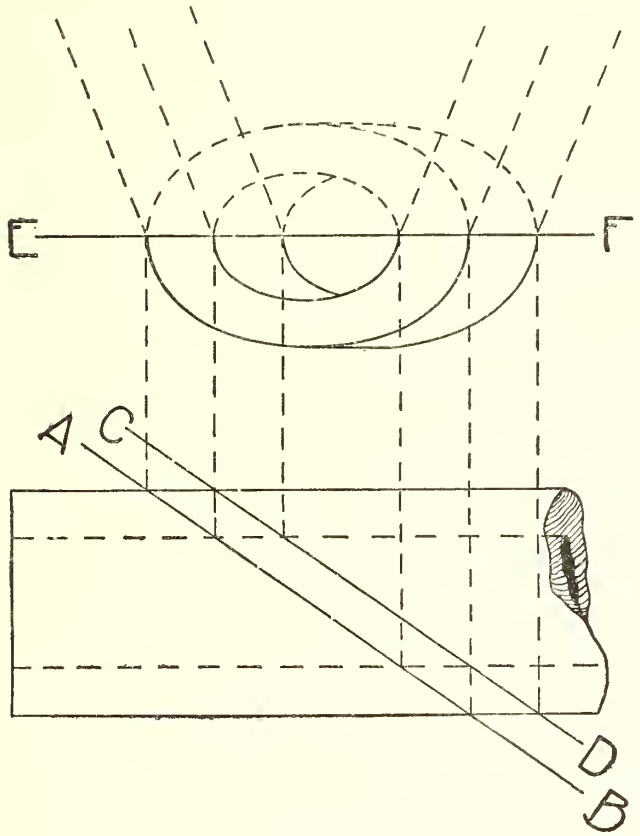


Fig. 171.

space will only permit of a brief description of one, that known as the "Square cut and Tangent," as being perhaps the most general in use, and also the most easily grasped by the tyro. The name *Square-cut* applies mainly to the cutting of the wreath pieces "square" with the face of the plank, and also to forming square or butt joints. The term *Tangent* refers to the method of setting out and determining the plane in which the section of rail is contained, by means of lines drawn tangentially to the curve of the rail on plan. The simplest illustration which can be given of the curve required to form a wreath in a hand-rail is obtained by imagining a slice to be cut from a hollow cylinder, as shown in Fig. 171. The cylinder is cut diagonally by the lines AB and CD. These lines are parallel to each other, the distance between them being equal to the depth of the hand-rail in the square. The slice so cut is projected into elevation as shown, and cut through its axis by the line EF. By then eliminating half which is shown dotted, and assuming the hand-rails joined to the remainder as shown, the curve of wreath is complete. It will, of course, be understood that this would not do for a hand-rail, as it is all across the grain, but it serves as a model to illustrate the principle, the object now being to obtain a rail of similar form, but with the grain following the curve. The curve shown in Fig. 171 is for a half-turn wreath, and such must always be made in two pieces, jointed in the middle in order to avoid cross grain. Quarter-turn wreaths are worked from a single piece.

Fig. 172 shows the various drawings necessary for setting out a wreath over quarter-space winders on the tangent system. The first step is to draw an exact plan of the winders, with two or three flyers above and below, as at (1), Fig. 172. On this plan the centre line of the rail is shown in a firm line, the width of the rail being indicated by dotted lines. The next step is to draw the "stretch-out" of the centre line of the rail as shown at (2). To do this, draw the two lines A′A′ and C′C′ at a distance apart equal to the curved portion of the rail AC on plan, the curve being measured by taking a number of short steps with the dividers, this method being quite near enough for practical purposes. The points where the risers 11 and 12 occur are then measured off along the curved line AC on plan, and their position on the stretch-out is marked. The heights of the risers are then measured up either of the lines A′A′ or C′C′, and the stairs 10, 11, 12, and 13 are drawn upon the stretch-out. The stairs 8, 9, 14, and 15 are set out with the same going as is shown on plan. Now it is clear that the hand-rail should be the same height over each stair—that is to say, the hand-rail should be parallel with the nosing line. The nosing line is drawn, therefore, upon the stretch-out, and if it forms one continuous line, as in this case, it will be quite satisfactory. It sometimes occurs, especially when balanced winders are used, that the line connecting up the nosing line of the upper and lower straight portions of the hand-rail will fall above or below the nosing line of the winders, and either arrangement is a source of great danger to users of the stairs. In such a case there are two methods of overcoming this difficulty. If the stairs have not already been constructed, they should be again set out on the stretch-out, so as to give a more satisfactory *falling line*, as the centre line of the rail over the winders is called. If the stairs have already been constructed, then the falling line of the wreath must be adjusted so as to be as nearly as possible coincident with the nosing line of the winders, and where it joins the straight rails a slight curve or "easing" is employed, so that the slight difference in height of the

rail above the stairs is less perceptible to those who have to use the stairs. The more gradual the easing, of course, the less perceptible is the variation in height, but the thicker will be the stuff from which the wreath piece is cut.

The curved part of the hand-rail is now enclosed in a triangular prism ABC on plan, with the planes BA and BC tangential to the curve at the springings A and C. and a development, or stretch-out, is made of these tangent planes, as shown at (3), Fig. 172. To do this the prism is stretched out, the lines A″A″, B″B″, and C″C″ corresponding with the edges A, B, and C on plan. The risers are then projected upon this development from the stretch-out of the central line of rail. The treads are measured off the plan, and in the case of stairs 10, 11, and 12 the treads are measured off along the tangent planes AB and BC on plan. The centre lines of the upper and lower straights are drawn in their position above the nosing lines, the upper

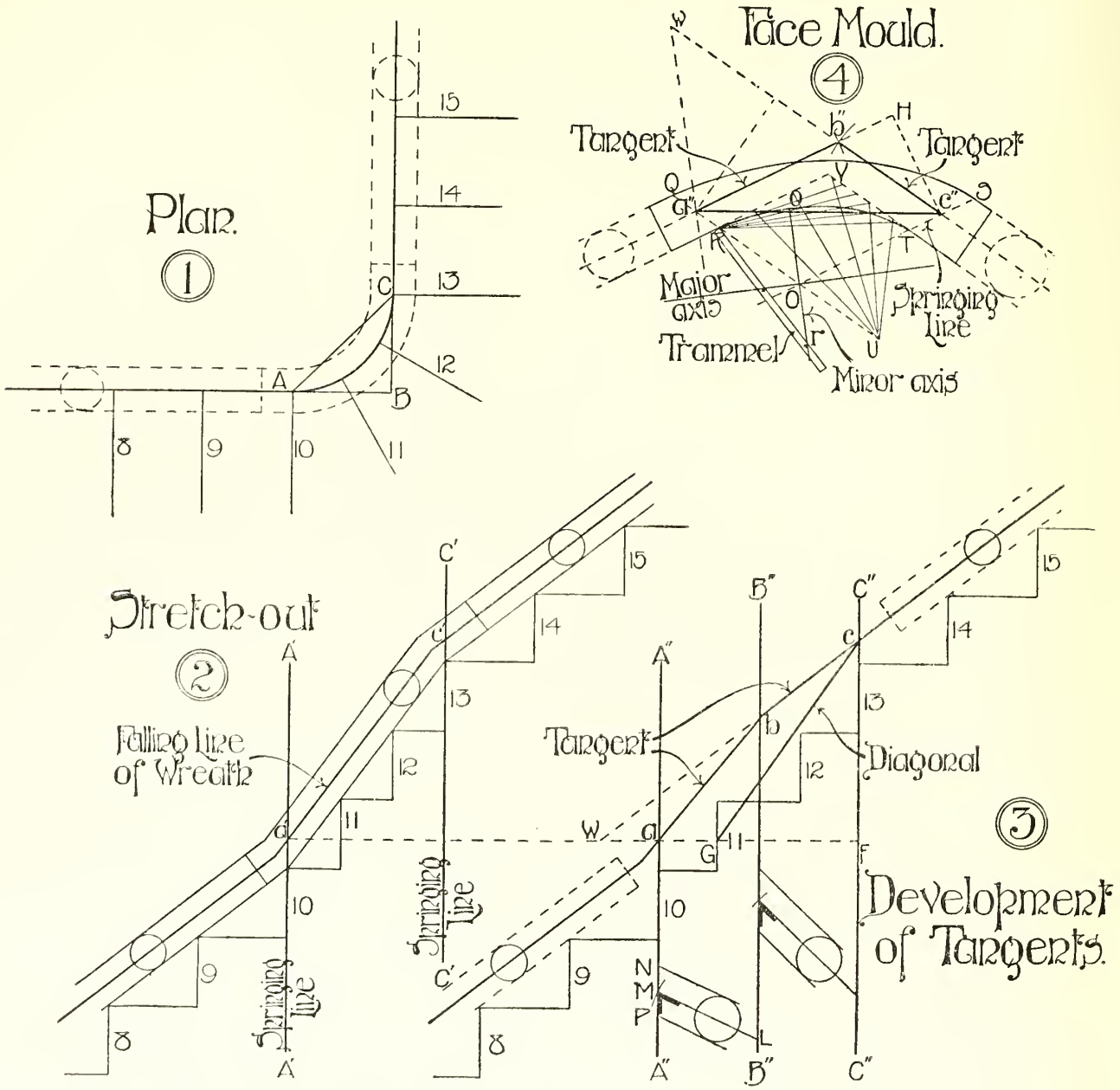


Fig. 172.

line being produced to cut the line B″B″ at *b*. The point *a′* on the stretch-out is then projected on to the point *a* in the line A″A″ on the development of the tangents, and the points *b* and *a* are joined and produced to meet the centre line of the lower straight rail. The distance FG is measured off along the level line through *a*, equal to the distance AC on plan, and *c*G is joined. It

should be noted that, if the drawing is correct, the point *c* on the development of the tangents will be level with the point *c'* on the stretch-out of the central line of the rail. The lines *ab*, *bc*, and *c*G are the true lengths of the sides of the section of the prism ABC, which contains the central line of the curved portion of the rail. To obtain the face mould, set down the line *a″c″* equal to G*c* (as shown at (4)), and with centre *a″* and radius *ab* describe an arc, and with centre *c″* and radius *cb* describe another arc, cutting the former arc at *b″*. Join *a″b″* and *c″b″*. *a″b″c″* is the true shape of the section of the prism containing the centre line of the rail. From *a″* and *c″* draw the lines *a″*O and *c″*O respectively, parallel to *b″c″* and *a″b″*. Then O is the centre of the elliptical curves bounding the face mould.

To obtain the width of the mould at the end *a″*, produce the tangent *a″b″*, and from *c″* draw *c″*H perpendicular to it. Take the distance *c″*H with a pair of compasses, and from any point L in the line B″B″ (3), and with radius *c″*H, strike an arc cutting the line A″A″ in M. Join LM, and with any point in LM as centre describe a circle with its diameter equal to the width of the rail on plan. Draw lines tangentially to this circle and parallel to LM, cutting the line A″A″ at N and P. Then with NM or NP as radius describe a circle with its centre on *b″a″* produced, as shown at (4), Fig. 172, and draw lines tangentially to this circle and parallel to *a″b″*, cutting the line O*a″* at Q and R. Then QR is the width of the mould on the springing line.

Similar construction is shown for finding the points S and T at the other end of the face mould. If lines drawn through Q and R parallel to *a″c″* pass through the points S and T respectively the accuracy of the setting-out will be proved. The points Q, R, S, and T are the points from which the elliptical curves are struck. To strike the curve RT, produce RC to U, making OU equal to RO, and draw RV and TV respectively parallel to OT and OR. Divide OT into any convenient number of equal parts, and TV into the same number of equal parts. From R draw lines to the divisions of TV, and from U draw lines through the divisions of OT; the points where these lines cut the first set of lines mark points on the ellipse as shown. The upper curve is set out in a similar manner.

These curves may be checked by finding the axes of the ellipse of which they form part, and trammelling the curves. This is done in the following manner :— Produce *cb* (3) to meet the level line through *a* at *w*. Produce *c″b″* (4) to *w*, making *b″w* equal to *bw* on the development of the tangents. Join *wa″*, and through O draw O*o* parallel to *a″w*; then O*o* is half the minor axis. Mark off the length O*o* from the unlettered marked point to its end R on a slip of wood called a "trammel," and place this in the position shown; its length R*r* being equal to the length of half the major axis, by placing the trammel in various positions with the two marked points on the axes, the end of the trammel will mark points on the curve of the required ellipse.

The joints are then drawn square with the tangents, and at the same distance from *a″* and *c″* as they are

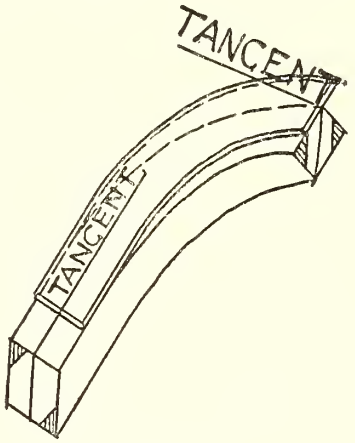


FIG. 173.

from the corresponding points on the development of the tangent. The bevels for setting the ends of the wreath piece are found when finding the width of the end of the face mould. These are shown blacked in at (3).

Having now obtained our face, mould, and bevels, theory ends and practice begins. The method of using the mould is shown in Fig. 173, the bevels being marked across the end of wreath piece, the shaded portions are worked off, the other angles being "squared" from these. When this has been done the wreath is complete up to the point known as "in the square." Each end should then in turn be jointed temporarily to the straight rail, and the moulding worked a little way on. It is then taken off and the mould completed.

CHAPTER VII

EXTERNAL PLUMBING

(Contributed by T. H. Bishop, A.R.I.B.A.)

External plumbing consists mainly in covering roofs with lead to make them weather-tight. If laid successfully, lead surpasses every other material, as it combines lasting and waterproof properties. In towns, lead coverings are more economical than zinc, the former being practically indestructible, while the latter requires frequent renewal.

The lead used for external work is of two kinds, cast and milled. Cast lead is lead molten and cast in moulds, and may be obtained in sizes up to 20 feet in length and 7 feet wide; it is hard and durable and suitable in positions subjected to great traffic, but has the disadvantage of being subject to flaws and sand-holes. Milled lead is first cast and then passed through rollers, which toughens it, and may be obtained in sheets 7 feet wide by 33 feet long, and from some manufacturers even longer, and 8 feet in width when specially ordered. When subjected to variations of temperature it changes its dimensions, and it is therefore not advisable to lay it in large sheets. It should never be rigidly fixed, as this interferes with its expansion and contraction, and the use of solder should be avoided where possible; care should be taken that the lead is laid so that the edges do not blow up. Lead does not rapidly decompose, and is usually protected by a coat of oxide; it decays rapidly when in contact with damp wood, and by galvanic action through being brought into contact with zinc or copper. It is also rapidly destroyed by some acids, and by decaying vegetable matter.

Lead is specified by weight. The following table gives its weight and corresponding thickness:—

Weight in Lbs. per Foot super.	Thickness in Inches.	Weight in Lbs. per Foot super.	Thickness in Inches.
1	0.017	7	0.118
2	0.034	8	0.135
3	0.051	9	0.152
4	0.068	10	0.169
5	0.085	11	0.186
6	0.101	12	0.203

Lead usually expands .00285 of its length between 32° and 212° Fahr.

The following weights of lead can be recommended for their varying positions:—

Roofs, flats, and main gutters	7-lb. lead.
Hip ridges and small gutters	6 ,,
Flashings	5 ,,
Soil pipes	8 to 10 ,,

No length of lead should be used exceeding 7 feet, and there should be no nailing unless absolutely necessary.

Bossing is working lead to the required angles with boxwood dressers, and is prferable to soldering where the lead does not exceed 12 inches in depth, as soldered joints are liable to crack.

Lead tacks, sometimes called tingles, are narrow strips of lead from 1 to 2 inches in width, used to secure one of the free edges of the lead.

Passings, which are usually 4 inches, are laps of one piece of lead over the adjoining piece, when the lead cannot be used in one length.

Raglets are grooves or chases cut into brick or stonework about $1\frac{3}{4}$ inch deep, to receive the turned-in edge of the lead flashings.

Cover flashings, usually 6 inches wide, are used to cover the edges of flashings turned up against walls to prevent rain from driving in, and to allow the lead underflashing to expand.

Apron pieces are the lower horizontal flashings of a chimney shaft or wall, and are 6 inches deep.

Tilting fillets are usually of wood, triangular in section, used where inclined surfaces abut against walls, to tilt the slates or tiles so that they carry the water away from the weakest points.

The joints usually used in external leadwork are:—

Joints across the flow or current.—Lap and drip joints.

Joints parallel with the flow.—Rolls, hollow rolls, seams or welts.

Lap joints are used when inclined surfaces of pitched roofs are covered with lead. The length of the boards should be placed parallel to the inclination. The lead is then fixed between rolls, the upper sides being turned over the boarding, and copper nailed so that the sheet is secured from sliding. The lower edge of the upper sheet should lap on the top edge of the lower. If the roof has an inclination of not less than 45 degrees, 6-inch lap is sufficient; but if the angle of roof is less than 45 degrees, the lap should be increased or a drip formed.

Ridges.—These should be in 6-lb. lead, in lengths not exceeding 7 feet. There is a choice of two ways in fixing ridges—

1. The lead tacks, or copper clips, are first nailed to the ridge board, and the wood roll (never less than $1\frac{1}{2}$ inches in height) is then fixed. The lead ridge is then dressed over the roll and secured by the lead tacks or copper clips (see Fig. 174).

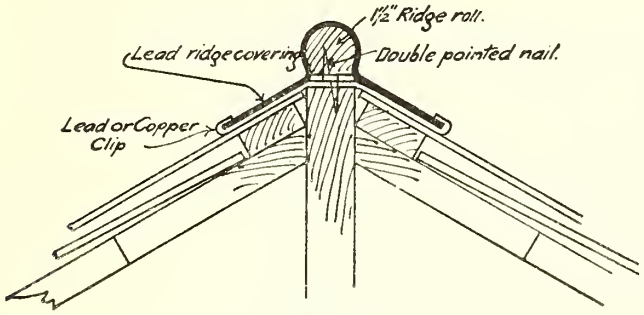


Fig. 174.

2. The lead can be nailed direct on to the roll, and the tacks nailed to the tilting fillet abutting on the ridge board (see Fig. 174).

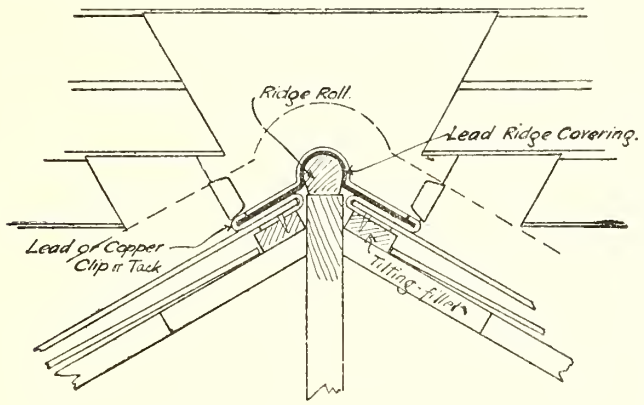


Fig. 175

In all cases the lead should be well dressed into the bottom edges of the roll, and should lie 6 inches on the slates or tiles on each side of the ridge. The joints are formed by lapping the lead.

Valleys and Hips.—If the inclinations of two roofs form a hollow, that hollow is called a valley; and if they form a ridge, it is called a hip.

Hips may be made watertight in three ways—

1. By dressing lead of similar size as described for ridges. The lower end is bossed over the end of the hip and securely supported by a lead tack placed in the centre of each length of lead, as shown for ridges (Fig. 175).

2. The hips may be formed by soakers. These are small pieces of lead, one to each slate, made to lap over one another. They are fixed over the roll, where they are visible, or the roll may be omitted in order to save lead.

3. In some cases a secret gutter is formed, as shown

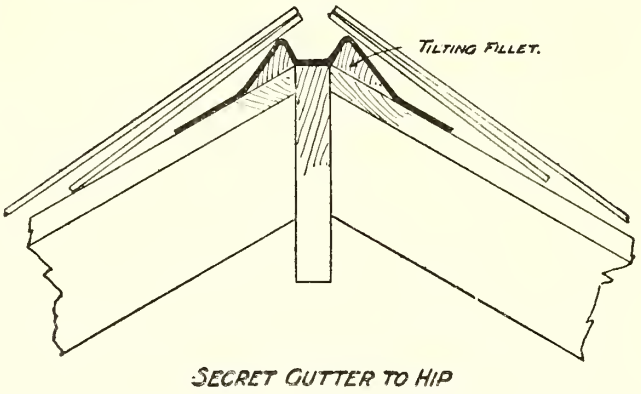


Fig. 176.

in Fig. 176, and the slates are then cut close. This forms a very neat finish.

Valleys may be arranged to form a small gutter, the lead being dressed over fillets, as shown in Fig. 177

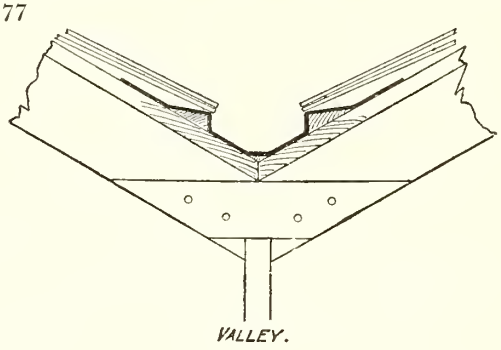


Fig. 177.

Stepped Flashings.—One method of protecting the building where sloping roofs abut on walls or parapets is by the use of stepped flashings. These are pieces of 5-lb. lead, lying 6 inches on the roof and turned up 6 inches against the brickwork. The upper edges are turned $1\frac{1}{2}$ inch into the joints of the brickwork, and secured with lead wedges as described under the head of flashings. The flashings should be turned $2\frac{1}{2}$ inches up the wall before the lead is cut for the stepping (see Fig. 178).

Raking Flashings.—Raking flashings are similar to those before described, except that the lead is secured in a chase cut parallel to the slope of the roof.

Chimney Flashings.—Fig. 178 shows the mode of keeping out the wet on the four sides of a chimney stack; at the lower end by an apron piece fixed with lead wedges and tacks, at the sides by clipped flashings or secret gutters, and at the back by means of a gutter.

Secret Gutters are 2 inches wide, laid up sides of chimneys, walls, or hips. In the case of a chimney or a wall the lead is turned up the brickwork and fixed

into a raglet with lead wedges. On the other side it is turned over a fillet, and in some cases a hollow welt is formed under the roof covering.

The slates are carried over the secret gutter, but as to flashings, as there is less likelihood of the wind driving the water under the flashings, especially where the slope of the upper portion of roof intersects the lower portion at an acute angle.

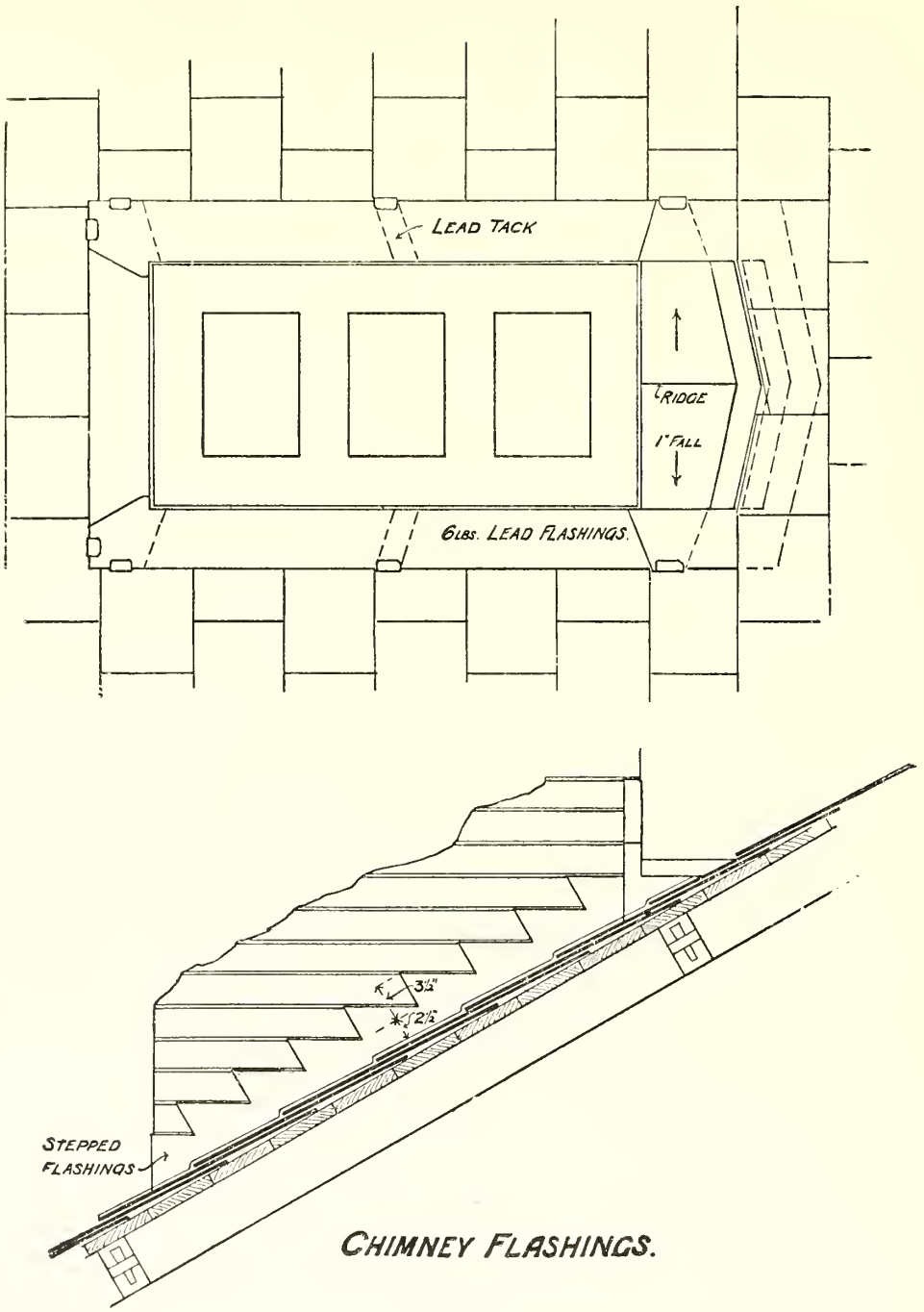


FIG. 178.

this method does not allow them to be easily cleared it is better to show the slates fixed 2 inches clear of the wall.

In some cases the boarding is cut back to give additional depth to the gutter.

Side Gutters are often used to convey the water from the upper portion of Mansard roofs, and are preferable

Soakers.—The intersections of sloping roofs with gables, chimneys, or parapet walls are sometimes made watertight by pieces of lead or zinc called soakers, fixed parallel to the wall, resting 4 inches on the slope, and turned up against the walls 2 to 3 inches. A cover, stepped or raking, flashing is fixed over the

turned-up edges. Soakers should be the length of the slate, minus the margin, plus 1 inch for clipping over the head of the slates. At times the soakers are turned up against the wall 6 inches, and steps are cut in same and treated as stepped flashings.

Parapet Gutters.—When the gutters adjoin parapet walls they are termed parapet gutters. These are of two kinds, parallel and tapering.

If the rafters are fixed to the wall-plate a tapering gutter is used.

Should the rafters be fixed to a pole-plate a parallel gutter must be used, but the pole-plate must be of sufficient depth to allow for the neeessary falls and drips.

The lead in both eases is turned 6 inches up the walls and finished with a cover flashing, and on the roof side it is dressed over a tilting fillet and rests 3 inches on the boarding beyond.

Tapering and Parallel Valley Gutters.—If the rafters are fixed on to the wall-plate a tapering gutter is formed, in a similar manner to that described for tapering parapet gutters, except that the lead is turned up under the slates on both sides of the gutter.

Parallel gutters are formed where the rafters are fixed to pole-plates. These are similar to the parallel gutters before described, except that when the gutter exceeds 12 inches in depth an apron pieee is used in place of turning the lead under the slates.

In the ease of M-shaped roofs it is sometimes desirable to take the water through the roof into an adjacent gutter. These are termed box gutters, and are made by forming wrought timber troughs from 4 to 6 inches in width and lining them with lead.

Burning in.—Is the method of fixing lead eover flashings of gutters into a stone blocking course. A dovetail groove or raglet is cut into the stone, molten lead is then poured into the groove, and the lead caulked, —that is, driven into the groove with a blunt chisel.

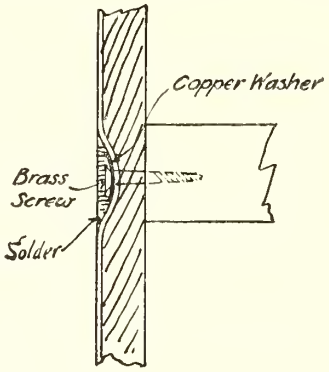
Lead Dots or Dowels.—When stone eornices or string courses are eovered with lead to protect them from the weather it is necessary to seeure them so that the wind does not turn up the edges.

The lead is laid before the blocking course is built. If the bloeking eourse is of brick the lead is turned into a horizontal joint. Should the wall have been built first, the lead must be turned into a horizontal joint and wedged with lead wedges.

To prevent the lead being turned up by the wind, circular dovetailed holes are made in the lead and stone exactly opposite each other, and the edges of the lead around the hole slightly turned up. An iron mould having a small hole in the top is pressed over the hole in the lead and stone, and molten lead is poured through the hole into the stone. This also fills up the cup-shaped hollow in the mould and forms a "lead dot."

Soldered Dots and Secret Tacks.—In fixing lead to vertical surfaces such as dormer eheeks, two methods are available:—

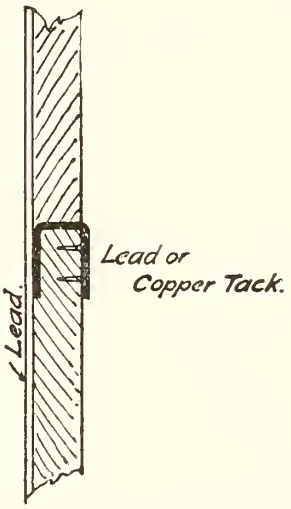
1. *The Soldered Dot.*—To form this a circular hollow 3 inches in diameter is formed in the boards. The lead is then well dressed into the hollow and serewed to the boards or studs (studs for preferenee), a tinned eopper washer having been first plaeed under the head of a tinned brass screw. The copper washer distributes the fixing over a large surfaee and prevents the lead being torn by the screw when expansion takes place; a ring of "soil" (composed of size, lamp black and chalk) having been painted on to prevent the solder from adhering to the flush surfaces of the lead. The hollow is then filled in level with plumber's solder (see Fig.



SOLDERED DOT.

FIG. 179.

179). The disadvantage of this method of fixing is that cracks are liable to oeeur round the edges of the soldered dot.



SECRET TACK.

FIG. 180.

2. *The Secret Tack.*—A better method of fixing dormer eheeks is shown by Fig. 180.

This is formed by hollowing out the boarding and

soldering a lead tack or copper clip to the back of the lead covering. The loose end is passed through a slot in the boarding, and copper nailed on the inside. This secures the lead as firmly as the soldered dot, and is not so unsightly.

Soil and Waste Pipes.—These may be executed in either iron or lead.

The following are the weights of lead soil pipes :—

Diameter.	Weight per 10 Feet length not less than
$3\frac{1}{2}$ inches	65 lbs.
4 ,,	74 ,,
5 ,,	92 ,,
6 ,,	110 ,,

Lead soil pipes are durable, easily cleaned, and less corrosive than iron ; their wiped soldered joints (Fig. 181) are more reliable than the caulked leaded joints of

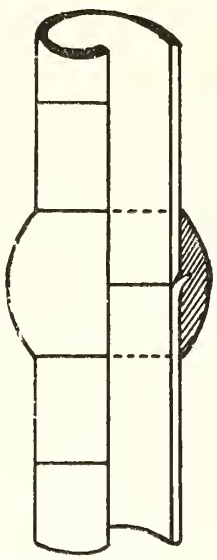


Fig. 181.

cast-iron pipes, and there are fewer joints in lead than in iron pipes.

The joints in soil pipes should be "wiped." This operation is performed by opening the upper end of the lead pipe by means of a tan pin, when the end of the remaining piece is filed to a sharp edge on the external face, the pipes are then fitted together and the internal faces kept true. The two ends are covered with "soil" for about 3 inches from the extremities, and the pipes for about $1\frac{1}{2}$ inch from each end are scraped bright by a shave hook. The pipes are then placed together and secured in position, molten solder being poured on from a ladle and wiped round to shape with a greased cloth. The solder adheres to the part that has been shaved, and forms a sharp line at its junction near the soil (see Fig. 181).

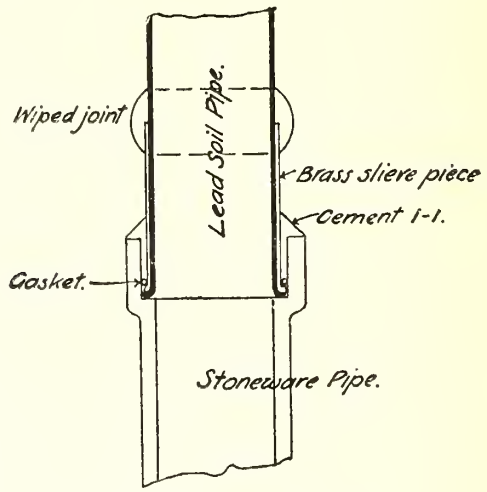
Plumber's solder is composed of three parts, by weight, of lead to one part of tin.

To prevent sagging or telescoping, lead soil pipes are supported every 5 feet by a pair of tacks soldered to the soil pipe and securely nailed to the walls.

Lead soil pipes can be obtained tinned inside. The tinning, however, is liable to chip and present a rough surface to collect foul matter.

Fig. 182 shows the connection of a lead soil pipe with the drain. A brass or gun-metal sleeve piece or thimble is threaded on to the end of the pipe, and the lead is bossed over the projecting fillet of the thimble. The top part of the thimble is secured to the soil pipe by a wiped joint. The thimble is then placed in the drain socket, and the joint made with Portland cement 1 to 1.

Soil pipes should be continued up full bore as ventilators, and protected as stated in the Chapter on Drainage.



JOINT BETWEEN LEAD SOIL PIPE & STONEWARE DRAIN.

Fig. 182.

Sink, Bath, and Lavatory Wastes.—These are generally of lead, and vary in sizes from $1\frac{1}{2}$ to 3 inches. They are secured to the wall by lead tacks, and connected to the drains in a similar manner to the soil pipes, except when discharging over an open channel.

The following are the weights for different sizes of lead pipes :—

Sizes.	1 Inch.	$1\frac{1}{4}$ Inch.	$1\frac{1}{2}$ Inch.	2 Inches.
	Lbs.	Lbs.	Lbs.	Lbs.
Middling .	7	$10\frac{1}{2}$	12	14
Strong . .	$10\frac{1}{2}$	14	18	24
Extra strong .	12	16	21	28

Cast-Iron Vent, Soil, and Waste Pipes.—Iron soil pipes are generally used at the present time on account of their strength, as they stand expansion

and contraction better than lead. No iron soil pipe should be less than $\frac{1}{4}$ inch thick for outside situations, and joints should not be made in the walls. Iron soil pipes have more joints than lead pipes have, the former being cast in 6-feet lengths, whilst the latter are made in lengths of from 10 to 12 feet.

The pipes should be fixed clear of the wall by being nailed through lugs which are cast on the pipes, or they should be secured by wrought-iron collars, the back part of which is built into the wall, and then the two parts are screwed together.

The following table gives the weights of cast-iron soil pipes :—

Thickness of Metal not less than		Weight per 6 feet length (including Socket and beaded Spigot or Flanges at least $\frac{1}{4}$ inch thick) not less than :—
$3\frac{1}{2}$ in.	$\frac{3}{16}$ in.	48 lbs.
4 ,,	$\frac{3}{16}$,,	54 ,,
5 ,,	$\frac{1}{4}$,,	69 ,,
6 ,,	$\frac{1}{4}$,,	84 ,,

Iron soil pipes are finished at the top in the same manner as lead pipes, and the joint connecting them to the drain is made by first placing a ring of spun yarn, or a lead flange cut to fit, inside the socket of the stoneware pipe. The beaded spigot is then inserted into the drain pipe, and the joint made in cement 1 to 1.

In modern practice sink, bath, and lavatory wastes are executed in iron, as there is less expansion and contraction by the hot and cold water. They are secured to the wall and connected to the drains in a similar manner to the soil pipes.

Should the bath waste be clear of windows it can be discharged into a cast-iron hopper head, and so conducted to the gulley.

If, however, it is near windows, it should be connected to the junction of the cast-iron pipe, and then that pipe continued up above the eaves as a vent, the bottom end discharging over a gulley or into a slipper, as before stated.

CHAPTER VIII

DRAINAGE

(Contributed by T. H. Bishop, A.R.I.B.A.)

Of all the units that make a satisfactory house, the drainage should receive the most careful attention; a good system being absolutely necessary for the health of the inhabitants.

At the present time bad drainage should be considered a disgrace, although Acts of Parliament and Local Bye-Laws make a high standard of sanitation compulsory. Yet sanitary work in general leaves much to be desired.

It is the duty of householders to see that their drains, manholes, and other fittings are kept clean and periodically flushed. Unfortunately, however, the average householder imagines that drains are automatic, and need little or no attention.

A solution of 1 oz. of sulphate of iron in 2 gallons of water, if passed through the drain, will sufficiently cleanse it.

In constructing a satisfactory scheme of drainage the following points should be observed:—

1. Complete disconnection of house and rain-water drains from the sewers and cesspools.

2. Disconnection of bath, sink, and other waste pipes from the drains, and their discharge over properly constructed gulley traps.

3. Ventilation of drains by providing an inlet ventilator to the intercepting chamber and outlets at the highest points of the system.

4. Drain pipes should be as small as possible, and of glazed stoneware, laid to self-cleansing gradients.

Gradients.—The general rule as to gradients of drains is:—

4-inch drain	1 in 40
6 ,, ...	1 ,, 60
9 ,, ...	1 ,, 90

These gradients give velocities of from $2\frac{1}{2}$ to 5 feet per second. A considerable saving in excavation is made, and the best results obtained, by adopting the moderate gradients in the table on next page; steep gradients are undesirable, as they allow the liquid to run away, leaving the solids behind to putrefy and cause a nuisance.

The following table shows self-cleansing velocities (Beardmore):—

.50 ft. per second will not disturb clay and stones.
.60 ,, ,, will not move along coarse sand.
1.00 ft. per second will move along fine gravel the size of peas.
2.00 ,, ,, will move along round pebbles 1 inch diameter.
3.00 ,, ,, will move along angular stones $1\frac{3}{4}$ inch diameter.

From this it will be seen that the velocity should never be less than 3 feet per second.

It has been proved by experiment that the velocity of the flow of liquid in a pipe varies as the $\sqrt{RS}$, when R is the "hydraulic mean depth" (which is equal to $\frac{\text{sectional area of ABCE}}{\text{the wetted perimeter ABC}}$), and S the gradient of the pipe.

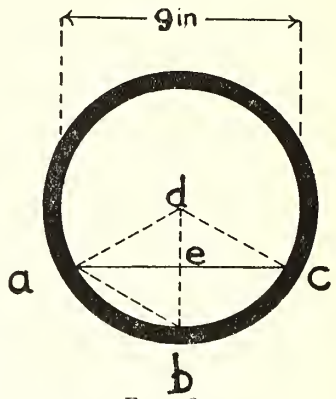


Fig. 183.

The hydraulic mean depth of pipes running full or half full is $\frac{\text{diam.}}{4}$, always in feet. For intermediate depths the hydraulic mean depth can be calculated in the following manner, which avoids the use of trigonometry (see Fig. 183).

The wetted perimeter should be first found by the following rule:—

$$\frac{8\,AB - AC}{3}.$$

Assuming a 9-inch pipe running a quarter full (see Fig. 183),

then $AC = 2\,AE$.

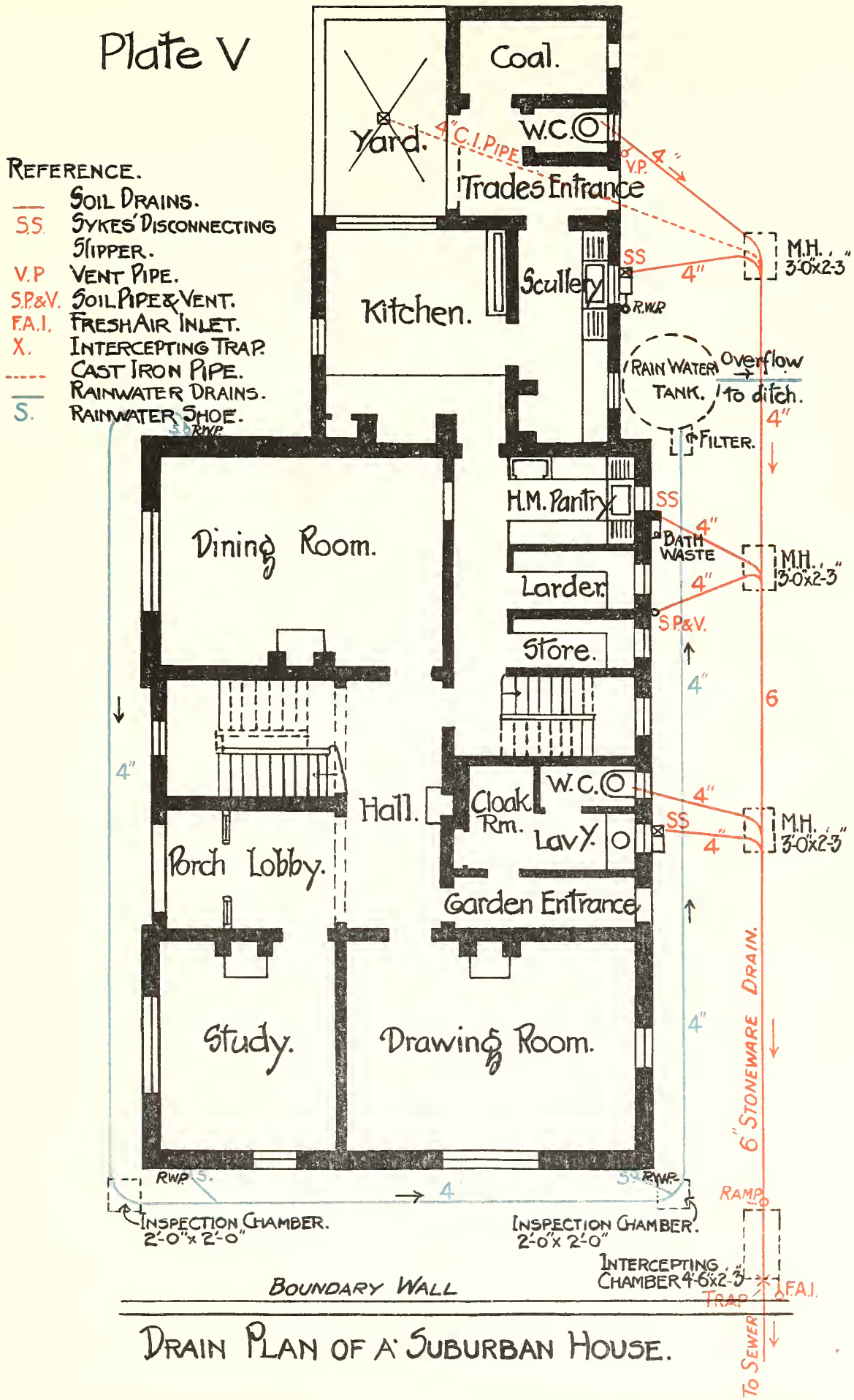
But $AE = \sqrt{AD^2 - DE^2}$ (Euclid, I. 47) $= \sqrt{4.5^2 - 2.25^2}$

$= \sqrt{15.19} = 3.9$ nearly.

$\therefore$ $AC = 2 \times 3.9 = 7.8$ = chord of whole arc.

We have now to find the chord of half the arc, namely, the length of AB.

Plate V



DRAIN PLAN OF A SUBURBAN HOUSE.

$$AB = \sqrt{AE^2 + EB^2} = \sqrt{3.9^2 + 2.25^2}$$
$$\sqrt{20.27} = 4.5 = \text{chord of } \tfrac{1}{2} \text{ arc.}$$
$$\therefore\ AB = 4.5.$$

Then

$$\frac{8\,AB - AC}{3} \quad \frac{8 \times 4.5 - 7.8}{3}$$
$$\frac{36.0 - 7.8}{3} = \frac{28.2}{3} = 9.4.$$
$$\therefore\ 9.4 = ABC = \text{wetted perimeter.}$$

$$\text{Section area of ABCE} = \frac{ABC \times DB}{2} - \frac{AC \times DE}{2}$$

$$\frac{\overset{4.7}{\cancel{9.4} \times 4.5}}{\underset{2}{\cancel{2}}} - \frac{\overset{3.9}{\cancel{7.8} \times 2.25}}{\underset{2}{\cancel{2}}} = 21.15 - 8.77 = 12.38.$$

$$HMD = \frac{A}{P} = \frac{12.38}{9.4} = 1.31 \text{ inches} = \frac{1.31}{12} \text{ inches}$$
$$= .11 \text{ feet nearly.}$$

The other variations of HMD can be found in a similar manner.

A formula which is easily remembered is Beardmore's variation of Eytelwein's. This gives flows which are slightly less than the actual, and it is widely used on account of its simplicity :—

$$V = 55\sqrt{HMD \times 2^{ce} \text{ fall in feet per mile.}}$$

When V = velocity in feet per minute.

HMD = Hydraulic mean depth in feet, $\frac{d}{4}$ for pipes running full and half full.

55 = Constant.

Example, find the velocity and discharge of a 7-inch drain running full, and laid to a gradient of 1 in 340.

1 in 340 = 15.5 feet per mile.

$$HMD = \frac{7 \text{ inches}}{4 \times 12}.$$
$$V = 55\,\frac{\sqrt{\overset{7}{\cancel{7}} \times \overset{2}{\cancel{2}} \times 15.5}}{\underset{4\ 2}{\cancel{4}} \times 12}$$
$$V = 55\sqrt{4.52}.$$
$$V = 55 \times 2.13.$$
$$V = 117.15 \text{ feet per minute.}$$
$$V = \frac{117.15}{60} \quad 1.95 \textit{ foot per second.}$$

The discharge of this pipe per second is

$$\text{diameter}^2 \times .7854 \times 1.95 \times 6.25,$$
$$= 3.24 \textit{ gallons per second.}$$

The following table worked on the above formula gives the Rate of Inclination for velocity per second for pipes running full :—

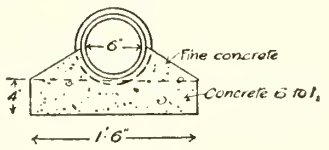
Diameter of Sewer.	Rate of Inclination of Velocity per Second.		
	2 Feet.	3 Feet.	4 Feet.
4 inches .	1 in 182	1 in 83	1 in 46
6 ,, . .	1 ,, 278	1 ,, 123	1 ,, 70
7 ,, . .	1 ,, 330	1 ,, 143	1 ,, 81
9 ,, . .	1 ,, 416	1 ,, 185	1 ,, 104

Laying and Jointing.—Plate V. shows the drain plan of a suburban house, and may be taken as a typical example, as in larger houses the several points are duplicated, whilst the principles remain the same.

The trenches having been excavated to the required depths and gradients, a bed of concrete, 6 to 1, varying in thickness with the diameter of pipes (see Fig. 184), is deposited in the trenches, lightly rammed, and graded to the required falls, with bricks lightly bedded in same where the socketing of pipes occur. These bricks are taken out when the drains are laid, so that the pipes bed firmly on the concrete. The concrete should be 12 inches wider than bore of pipes, and not less than the following depths :—

4-inch pipe . 3 inches deep.	7-inch pipe . 4 inches deep.
6 ,, . 4 ,,	9 ,, . 4 ,,

The pipes are then laid in position, a good fillet of neat cement or cement mortar 1 to 1 is laid on the

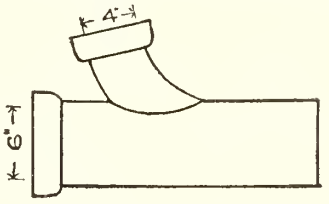


Concrete Benching

Fig. 184.

bottom of the socket and on the top of the spigot of the adjoining pipe and gently driven home. The remaining portion of the joint is then made, the cement weathered off, and the surplus cement inside cleaned off by a dolly or scraper. On the completion of the line of pipes they should be tested, and fine concrete bedded round to a height equal to half the diameter of the pipe, sloped off as shown on Fig. 184. The earth is then returned to the trenches and lightly rammed, care being taken that the pipes are covered to a depth of at least 18 inches before the ramming commences. If this precaution is neglected the newly made joints are liable to be broken.

When the main line of drains has been laid the trenches can be continued in a similar manner to the

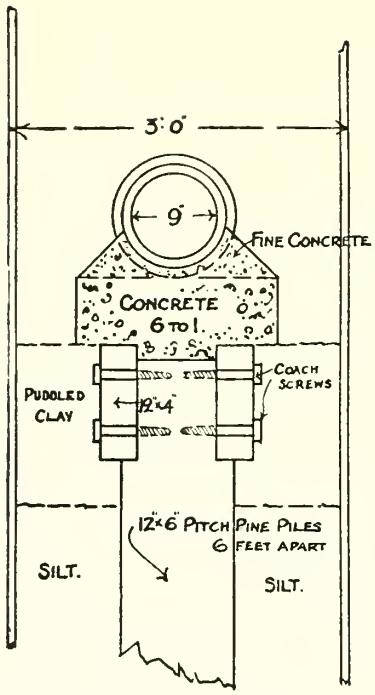


Junction

Fig. 185.

gulleys or soil pipes. Right-angled junctions should never be permitted, but special pipes with easy bends should be used (see Fig. 185). Connections should be made at the sides and not top of the pipes.

Fig. 186 shows a method of carrying stoneware



DRAIN SUPPORTED ON PILES OVER MARSHY GROUND.
FIG. 186.

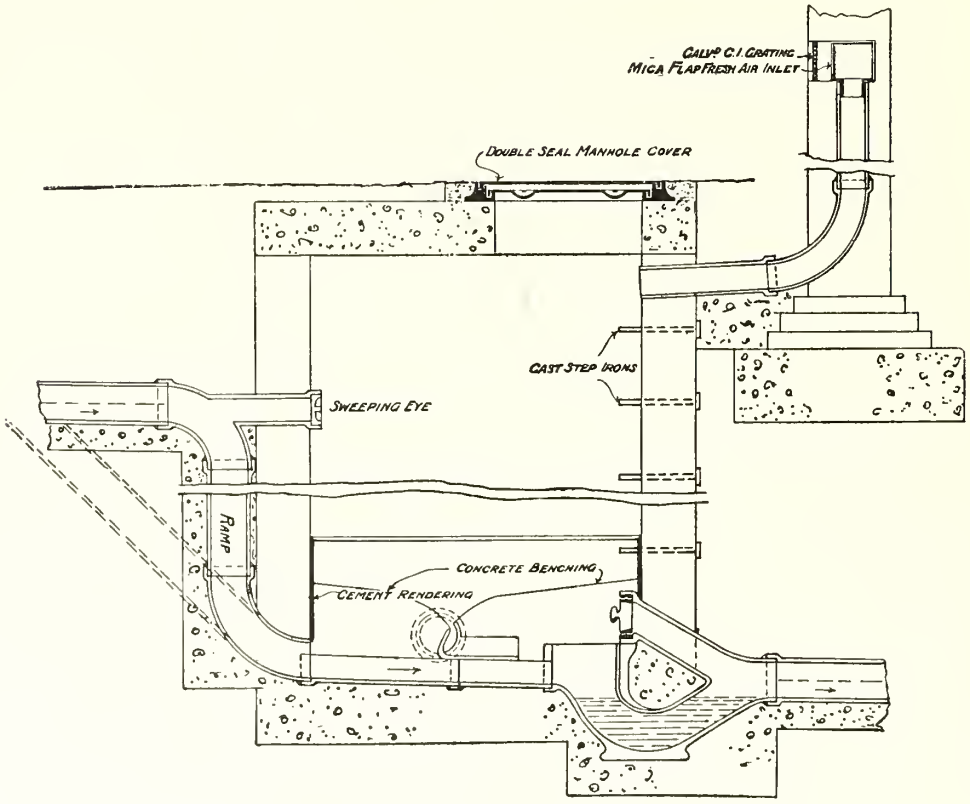
drains on marshy or silty ground. 12 by 6-inch piles are driven about 6 feet apart and two 12 by 4-inch runners secured to each side of these piles with coach screws. The bottom of the trench is then made firm by clay puddling, the concrete foundations put in, and the pipes laid in the usual way.

CAST-IRON PIPES.—When it is found necessary to carry a line of mains through a house, cast-iron pipes should be used and completely covered with concrete. These are made in 9-feet lengths, and weigh as follows:—

3	inches	$\frac{1}{4}$	-in. metal,	110	lbs.	per 9-ft. length.
4	,,	$\frac{3}{8}$	,,	160	,,	,,
5	,,	$\frac{3}{8}$	,,	190	,,	,,
6	,,	$\frac{3}{8}$	,,	230	,,	,,

Rust joints are sometimes used for iron pipes, but caulked joints are preferable, as the expansion of the rust cement when setting has a tendency to burst and crack the sockets of the pipes. The usual way is to make the joints with lead wire or molten lead and caulk them afterwards. Turned and bored pipes have been used, and it has been found that they readily adjust themselves to slight settlements.

The inside surfaces of pipes should either be coated with Dr. Angus Smith's solution, or glass enamel. The former is more generally used, the latter being costly and liable to chip and crack.

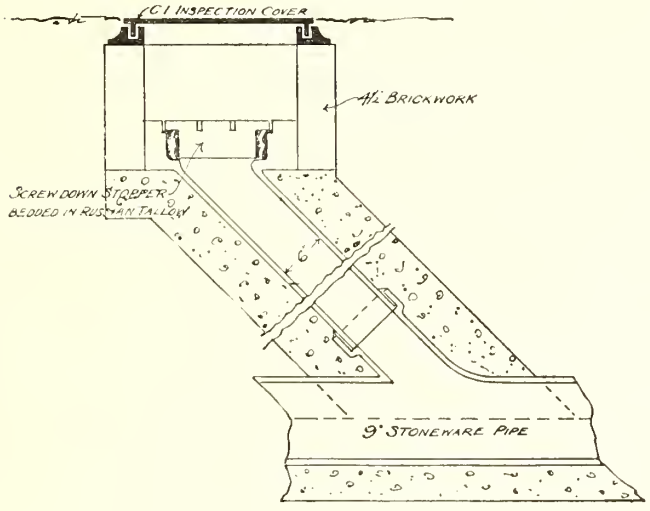


INTERCEPTING CHAMBER.
FIG. 187.

All junctions and bends should be arranged with cast-iron access pipes fitted with air-tight covers secured with brass screws.

Intercepting and Inspection Chambers.—Fig. 187 shows an Intercepting Chamber. These should be built in cement, on a concrete bed at least 9 inches thick, and finished on top with a double or single seal cast-iron manhole cover. The concrete foundation having been put in, the disconnecting trap is placed in position and set perfectly level. There are many varieties of intercepting traps in the market, but a satisfactory one should have a 3-inch weir action and 1½-inch water seal and sweeping arm.

The channel pipes (either ½ or ¾ section) and the various branches discharging over them are next fixed and benched round with concrete. A course of brick on edge should be placed on top of the straight half-channel, and the concrete sloped off to the edge of the



Sweeping Eye

Fig. 188.

channel thus formed. This will form a deep channel, which will prevent the excreta from being washed up on to the slopes out of the reach of the next discharge. The sides and slopes of the chamber should then be finished to a smooth surface in cement mortar, 1 to 1.

All half-channel pipes and bends should have 1-inch fall in their length in addition to the general gradient, to compensate for the loss of head due to friction.

Should the sewer be at a great depth, ramps may be used to save the expense of laying deep drains. These have a short arm with stopper fixed in same carried through the wall of manhole for rodding the drains.

Another form of ramp is that shown by dotted lines, the main pipe being continued full bore direct into the chamber, and a galvanised cast-iron flap valve fixed at the chamber end, to enable the sewage to flow into the chamber should the ramp become blocked.

The minimum internal dimensions of chambers should be 3 feet 0 inches by 2 feet 3 inches. In deep drains, however, they may be as large as 4 feet 1½ inch by 2 feet 7½ inches, and be gathered over at a height of 5 feet 6 inches above invert of drain, and continued to ground level with a shaft 1 foot 10½ inches by 1 foot 10½ inches inside dimensions.

Chambers over 4 feet deep should have step irons 1 foot 6 inches apart.

Where the distance between two inspection chambers exceeds 100 feet, sweeping eyes may be constructed, as shown by Fig. 188. These should be finished with a

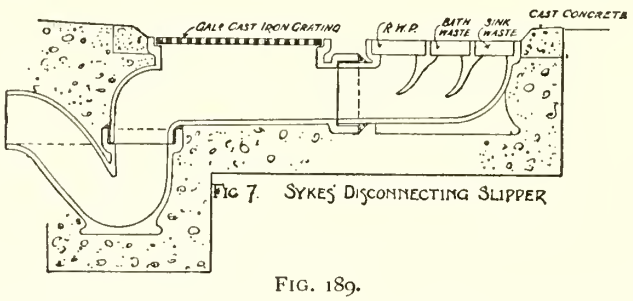


Fig 7. Sykes' Disconnecting Slipper

Fig. 189.

stopper bedded in soft soap and covered by a slab of York stone and a small hinged cast-iron cover. Inspection chambers are similar in construction to intercepting chambers, but the fresh-air inlet and intercepter are omitted.

Sink, Bath, and Lavatory Wastes.—There are several ways of dealing with these.

1. They may be connected to a Sykes' slipper, as shown on Fig. 189.

2. They may be discharged on to an open channel in accordance with the Model Bye-Laws.

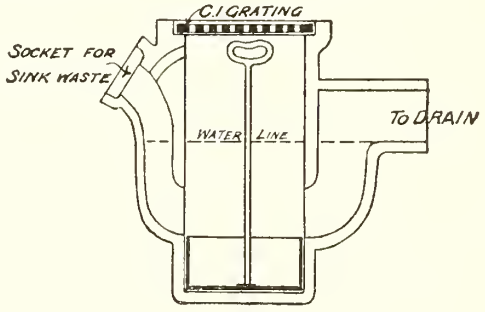


Fig. 190.

3. They may be connected to a grease trap, as Fig. 190.

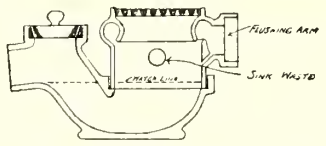
4. They may be connected to a flushing rim gulley, such as Fig. 191.

The advantages and disadvantages of the foregoing may be summed up as follows:—

1. Sykes' slipper is a deep glazed earthenware channel, covered by a movable cast-iron grating, and connected to a trap which can be set at any angle. It is without doubt an advantage to collect the wastes and connect them to one gully. But the grease thus collected should be cleaned off at least once a week.

2. This is a modification of the above, the channel having no grating, and possessing the advantage that the grease can be easily seen; it is, therefore, more likely to be kept clean.

3. Many forms of grease trap are on the market. They consist of a trap large enough to collect the fat from the greasy water, which is carried off by the sink wastes, and the inlet and outlet are under the water level. The wastes discharge under an open grid, and the bucket which rests on the bottom can be raised when required to remove the grease floating on the top, and any solid substances which have fallen



FLUSHING RIM GULLY
FIG. 191.

into it. As the result of a visit to Berlin by Dr. Gilbert Fowler of Manchester, a new form of grease trap is to be tried at Davyhulme. This trap is called the Kremer, and is made by David Grove of Berlin. Being recommended by so high an authority, it will be interesting to ascertain the results of the experiment.

4. A good example of the flushing rim gulley is Winser's (Fig. 191). A flush tank containing about 30 gallons, discharging at fixed periods, breaks up the grease and drives it through the drain.

The great objection to grease gulleys is that they become cesspools if not frequently cleaned out.

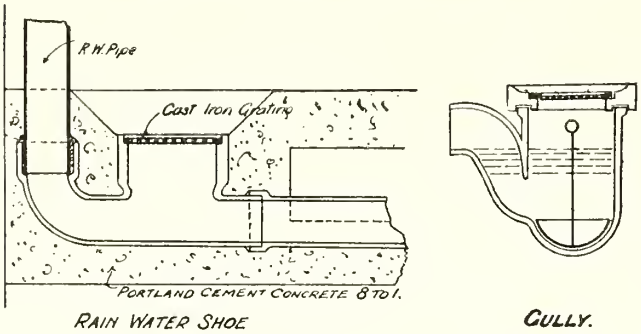


FIG. 192.

As regards flushing-rim gulleys, their expense precludes their general use in any but the largest houses.

For general cases, the open channel is probably the best.

RAIN-WATER AND SURFACE DRAINS.—In the country rain water is considered an advantage for washing, and care is taken to collect it (see Plate V.). Should it, however, be decided to run it into the drains, other arrangements must be adopted.

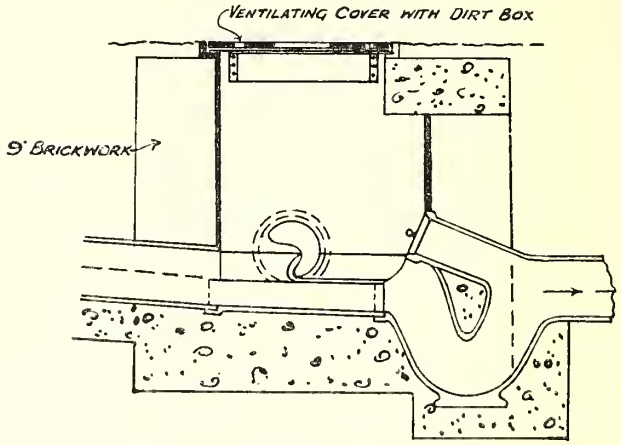
In any case, the rain-water system should be kept separate from the soil drains. Under these conditions R.W. gulleys are not needed, but the down pipes are connected to R.W. shoes fitted with movable galvanised cast-iron cover or grating (see Fig. 192).

If the R.W. drains are connected to the soil drains, gulleys are necessary, a good type of which is shown on Fig. 192.

After the whole of the drains have been collected they are disconnected from the soil drains by a disconnecting chamber (see Fig. 193). This chamber should have a ventilating cover, to ensure a good current of air through the drains, the down pipes acting as outlet ventilators.

Provided that no foul water is connected to them, surface drains can be connected to the R.W. system; but otherwise, they should be joined to the soil drains.

BALL TRAPS.—If the drains are laid at so low a level that the sewage can back up from the main sewer into the house drains, a ball trap of Couzens' or other make should be used. This consists of a copper ball



DISCONNECTING CHAMBER ON R.W. DRAIN.
FIG. 193.

floating in the trap, which, in the event of back flow, closes the opening on the house side of the drain.

FLUSH TANKS.—Owing to various local circumstances, it is sometimes found that drains must be laid to gradients that are not self-cleansing. In such cases it is advisable to fix a flush tank at the head of the drains. This may consist of a galvanised wrought-iron tank, or a brick chamber, in the bottom of which is fixed an Adams' or other flushing syphon (see Fig. 194). In this diagram a brick tank is shown, to which the bath or lavatory wastes are connected, or a $\frac{3}{4}$-inch pipe taken from the nearest water main, with a screw-down tap fixed on the end to regulate the discharge.

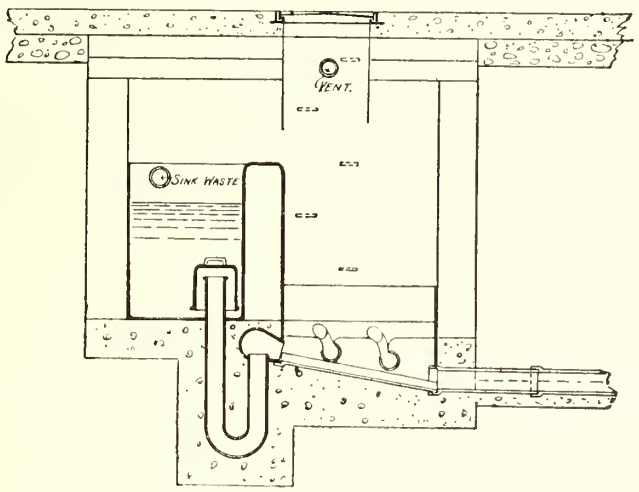
VENTILATION AND SIPHONAGE.—In order that the drains should act efficiently, and to avoid the accumulation of foul gases, it is necessary that they be continuously ventilated. This is effected by the difference in the density of the air between the inlet and the outlet ventilators.

The system usually adopted is to have a short fresh-

air inlet pipe at the lower extremity, and a tall outlet pipe at the head of the drain, and from the soil pipes. These outlets should be carried to a height well above all windows.

Each outlet pipe may be finished with an open end, or with a galvanised wire cage to exclude birds. The total area of the openings in the cage should be not less than the area of the outlet to the vent pipe. All outlet pipes which are not soil pipes should be at least 4 inches diameter.

The fresh-air inlet pipe is usually carried up from 4 to 6 feet above the ground, and connected to the disconnecting chamber; it should be fixed as far as possible from all door and window openings. It is generally fitted with a mica flap valve, which allows the air to enter but is closed by any back current. This inlet pipe should have a sectional area equal to the total areas of the various outlets, but in practice it is usually 4 or 6 inches in diameter.



FLUSHING CHAMBER.

Fig. 194.

Probably the best material for inlet pipes is glazed stoneware, because there is no rusting as in iron pipes, nor likelihood of damage as in lead pipes. In any case a lead inlet pipe should be cased.

Beyond the necessity of keeping the pipes clear of foul air, there is the question of siphonage (*i.e.* emptying the trap of its water).

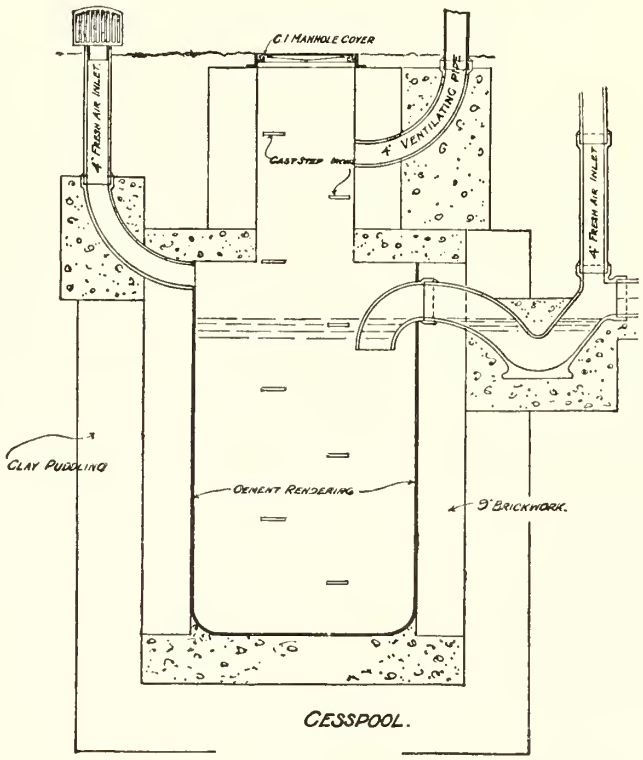
If a trap is discharged full bore a vacuum occurs. The pressure of the air at the intake of the trap, being then greater than at the outgo, causes either a part or the whole of the water to be forced out of the trap, and so renders it useless to stop the inflow of foul air.

In the same way, if two w.c.'s are placed one above the other, and connected to the same pipe and the upper one is discharged, the flow of water will syphon the lower one.

In both these cases this may be prevented by connecting a pipe, called the antisiphonage pipe, to the top of the trap. This pipe in the case of w.c.'s should be carried above the upper w.c., and connected to the soil pipe. While in the case of sinks and lavatories on the ground floor, or where there is no soil pipe handy, the antisiphonage pipe is taken through the external wall and has a brass grating soldered in the end, and is then called a puff pipe. Care should be taken to see that the trap is kept clean, otherwise water will find its way through the puff pipe and run down the wall.

Cesspools and R.W. Tanks.—In cases where there is no public sewer adjacent to the house the drains are connected to a cesspool (see Fig. 195), ventilated as shown.

Where the rain water is collected for daily use, R.W.



CESSPOOL.

Fig. 195.

tanks should be constructed in brick on a concrete bottom, and the walls inside rendered in Portland cement mortar, 1 to 1, and the top domed over and fitted with a cast-iron inspection cover. In order to keep the water as clean as possible a filter composed of gravel about $\frac{1}{2}$ inch diameter should be provided. The bottom of the filter should be kept at least 1 foot 6 inches below the inlet into R.W. tank to catch the sediment brought down in the drains.

Testing.—After the drains have been laid, and before they are covered with concrete, they should be thoroughly tested.

There are several methods of testing drains, namely:—

1. *Volatile Oil Test.*—Defects may be discovered by pouring oil of peppermint or ether and hot water down

the highest soil pipe and blocking the pipe and other outlets with a sack. If the odour can be traced from any part a defect exists. This test is not reliable, as defects may exist which may not be discovered by its application.

2. *The Smoke Test.* — In this test the drains are charged with smoke by means of a rocket or smoke machine which can be applied through the fresh air inlet, ventilating pipe, or gulley from which the water has been removed. An escape of smoke at any part will denote a defect.

3. *The Water Test.*—The most severe, and at the same time the most satisfactory, is the hydraulic test. An inflated indiarubber bag or an indiarubber plug is introduced into the drain at the intercepting chamber, and at any low-lying gullies on the system, which is then filled with water until the highest gulley overflows. Some authorities attach a standpipe to this gulley, giving an additional 5 feet of water pressure; but this is unusual. If after, say, half an hour the water level has lowered, it shows that a leakage has taken place.

The drains should be tested in lengths from the several inspection chambers. Care should be taken that the drains are not filled from two points at the same time, because an air-lock would occur, and the test would be useless.

CHAPTER IX

SANITARY FITTINGS AND THEIR PLUMBING

(Contributed by T. H Bishop, A.R.I.B.A.)

In Chapter VII. external plumbing was dealt with, up to the point of connection with internal fittings. This chapter deals with internal fittings, and their connections to the plumbing where it left off in the previous chapter.

Various Types of W.C.'s, and Water-Waste Preventers

Important as the question of external drainage is, the whole system would be a failure if the internal fittings were not of the best quality; and of all sanitary fittings the w.c. is the most important, in the choice of which too much care cannot be exercised.

The Valve Closet.—Although this has in a great measure been superseded by the washdown, it has still many advocates, and possesses some important advantages.

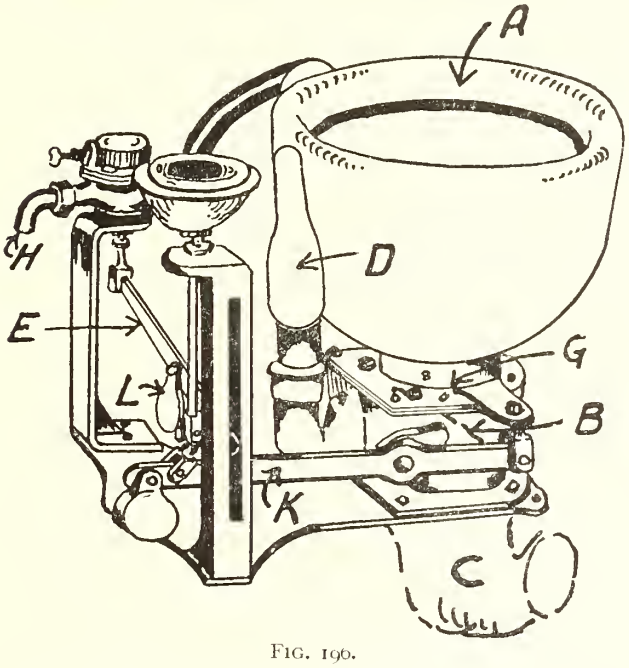


Fig. 196.

The illustration (Fig. 196) shows a Doulton's Valve Closet. It consists of three parts: the basin, the valve box, and the trap.

The advantages it possesses over the washdown are these:—

(1) It has a large water area to catch the fæces.

(2) A double seal, and close fitting valve.

(3) The foul air presses against the lower trap, saturates the water in it, and the gases are taken to the outside by the vent pipe.

(4) It is less noisy in use than the washdown.

The illustration is lettered as follows:—

A. Earthenware basin with flushing rim.
B. Valve box of cast iron, enamelled white inside.
C. Trap.
D. Overflow from basin, connected to valve box behind valve.
E. Arrangement for regulating the supply of water.
G. Flap valve, with rubber flange to keep water in basin (shown in dotted line as if open).
H. Supply pipe admitting water into basin.
K. Lever for opening and closing the basin valve.
L. Weight for shutting the supply valve.

These fittings, in most cases, act satisfactorily, but need a little attention, and, unless this is likely to be given, it is better to select some other form of closet. A wooden casing is generally considered necessary (although it serves as a harbour for dirt), as the complicated working-parts are unsightly, and are liable to catch in articles of clothing.

The water supply is wholly dependent on the person using the valve closet, the water running as long as the handle is held, until the cistern is emptied. This frequently leads to waste of water, and precludes the use of the closet in many districts where there is a restricted supply.

Washdown Closet.—A good washdown closet should possess the following points (Hellyer):—

(1) The pan should hold a body of water large enough and deep enough to quite submerge the fæces.

(2) It should have no places where fæcal matters can cling to or accumulate on.

(3) It should have a water seal of at least $1\frac{1}{2}$ inch for trapping off the soil pipe.

(4) It should be so constructed that the whole of its contents may be changed by a flush of two gallons of water, and its interior parts well flushed.

Washdown closets are made in two forms, either in one piece including the trap, or in two pieces with the trap separate. The latter is the better, as the pan is easily repaired without breaking into the

drain, a good example being Doulton's "Simplicitas" (Fig. 197). Like all good types of this closet, it is simple and cheap. It is made in pedestal form, well spread out to carry the weight, is fitted with a lift-up seat, and requires no casing. The water area is large, and deep enough to submerge the fæces.

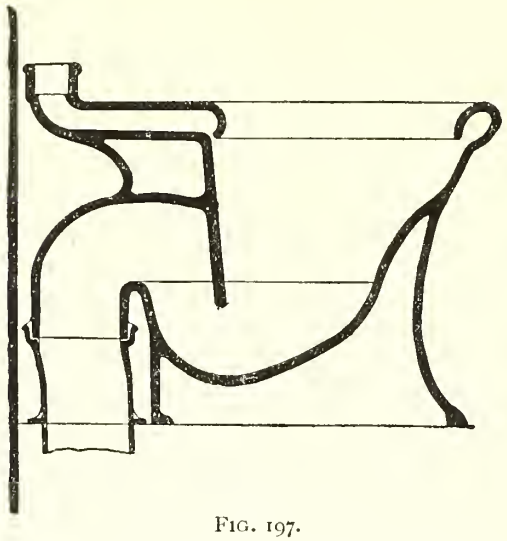


Fig. 197.

The flushing rim is sufficiently large, and the trap has a good seal, whilst the vertical connection for the down pipe from waste-water preventer obviates the use of a rubber cone, or the more objectionable rag-and-string joint.

The joint between the earthenware trap and the lead soil-pipe is usually the weakest part of this type of closet, and great care should be taken to make it perfectly air-tight. The London County Council's regulations for making this are as follow :—

"Any person who shall connect a stoneware or semi-vitrified ware trap, or pipe with a lead soil pipe, waste pipe, or trap communicating with a sewer, shall insert between such stoneware or semi-vitrified ware, trap, or pipe, and such lead soil pipe, waste pipe, or trap, a socket of copper, brass, or other suitable alloy, and shall insert such stoneware or semi-vitrified ware trap or pipe into such socket, making the joint with Portland cement, and shall connect such socket with the lead soil pipe, waste pipe, or trap, by means of a wiped or overcast metallic joint ; provided always that it shall be sufficient if he shall connect the stoneware or semi-vitrified ware, trap, or pipe with the lead soil pipe, waste pipe, or trap, in an equally suitable and efficient manner."

In connecting an earthenware pipe or closet to a lead soil-pipe, a socket is formed on the lead pipe by means of a plumber's "turning pin." The end of a brass collar or ferrule is fitted into this. Tallow is rubbed over the parts on which solder is to be placed, and then molten solder is poured around the joint and "wiped" into shape. The brass ferrule is jointed to the earthenware by means of a ring of gaskin (hemp), and neat cement is run in and wiped round. Pathogenic germs are retained in the hemp, and many authorities prefer the use of rings of some other material, such as rubber. In some cases the trap is made of lead instead of earthenware, so as to obviate this difficulty.

Probably the best joint is that known as the "Mettalo-Keramic" joint, a patent of Messrs. Doulton & Co. A short piece of lead pipe is fused by a patent process on to the trap, and the entire incorporation of the pottery and metal at the point of junction is effected.

The so-called *Hospital Closet*, of which Messrs. Doulton & Co.'s pattern is illustrated in Fig. 198, has the trap kept off the floor and fixed on brackets,

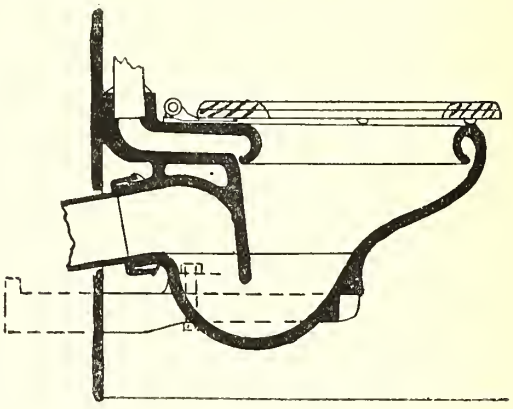


Fig. 198.

so that it can be washed down, and wiped over externally with a duster, thus obviating the collection of dirt and dust.

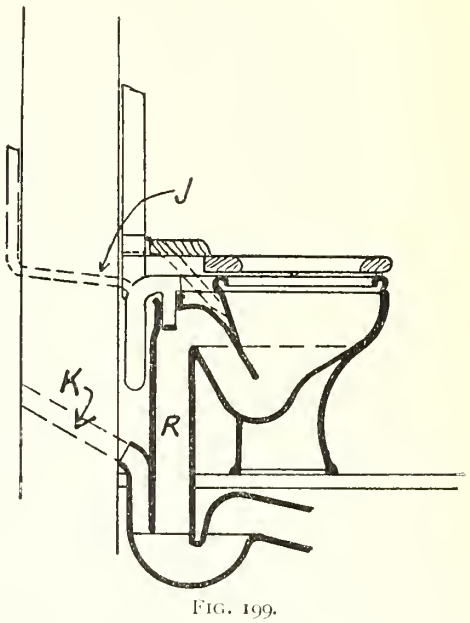


Fig. 199.

Siphonic Closets have found favour in recent years, and have all the advantages of the washdown form

with greater rapidity of flush and less noise in action, but they are somewhat more costly. A good type of this closet is Messrs. Jennings & Morley's (see Fig. 199). The water area is 12 by 10 inches, and the trap has a 3-inch seal. The incoming water expels the air through the pipe K and starts the syphonic action. The pipe J admits the air to the long syphonic leg R, and prevents the siphonage of the basin when

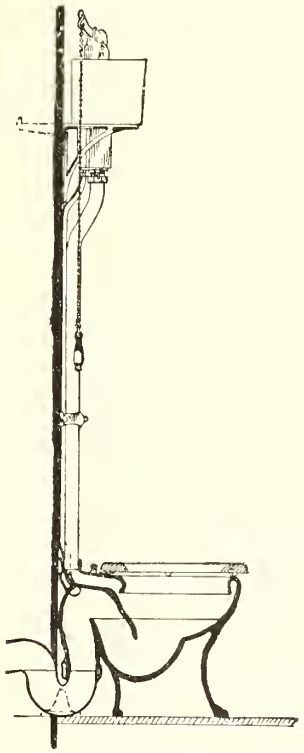


FIG. 200.

slops are poured into it. There are two connections from the service to the closet, one into the basin and the other into the long leg of the syphon R. This type of closet is much used in America. Doulton's pattern is shown in Fig. 200, and Davis & Bennett's in Fig. 201.

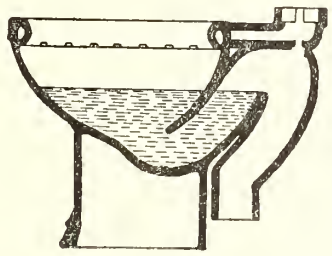


FIG. 201.

Closets are also made with thigh rests—that is, slips of hard wood inserted into the earthenware pan. These are more cleanly than wood seats, and are suitable for use in schools, and barracks.

Trough Closets are used in factories, schools, and barracks, but not now so frequently as formerly. The closet is flushed out by an automatic flush tank, which should hold enough water to completely flush the trough. It has been found, however, that the fæces collect at the back of the trough where the flush does not remove them. The late School Board for London substituted for the closets the washdown, which have been found to be almost as economical as regards the water used.

Automatic Flushing Closets of the washdown type are sometimes used in public buildings, the syphon being started by the moving of the seat when the user rises, or, by means of opening and shutting the door.

Water-Waste Preventers are used on all washdown closets and urinals.

There are many varieties on the market. The regulations of Water Companies, as a rule, restrict these to a 2-gallon flush, but a 3-gallon flush is preferable, and should be used where possible. Those acting on the syphonic principle, with a single pull and let-go, are the best. On the other hand, those requiring the chain to be held until the cistern is discharged should be avoided.

The illustration (Fig. 202) shows a Doulton's "Paisley," which, like many others, has proved very

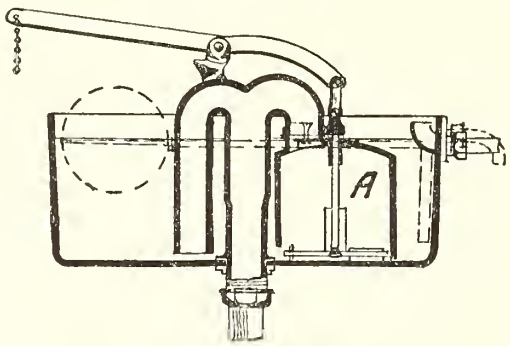


FIG. 202.

satisfactory in practice. The chain is pulled and lifts the disc in the chamber marked A, forcing the water over the bend, and forming a vacuum which starts the syphon. The cistern empties, and then refills to its normal level. This type is really a water-waste preventer, because the water must discharge out of the overflow should any of the fittings go wrong. The inlet and the overflow should be the same size, namely, $\frac{3}{4}$ inch, so that they can be changed if the cistern is not the right hand. The junction between the cistern and the supply to basin should be $1\frac{1}{2}$ inch, either in brass, lead, or iron; and the junction to the pan can be made either to a vertical inlet to pan by means of cement, or to a horizontal inlet by means of a rubber cone, or a screwed flange connection. The overflow from the cistern, which should always be 25 to 50 per cent. larger than the inlet (unless they be interchangeable), should be taken through the wall, and finished on the end with a copper flap.

Baths and their Wastes.—Baths are made of copper,

enamelled iron, or porcelain. They should not be cased in. but left open, so that they can be easily cleaned.

Porcelain baths are very cleanly, and are now much

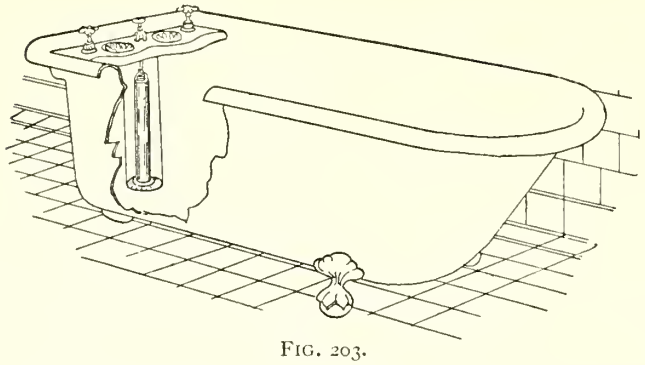


Fig. 203.

used, but they absorb a great deal of heat from the water, and are heavy and costly.

Fig. 203 shows an enamelled cast-iron bath with a rolled edge, the standing waste acting as an overflow, a detail of which is shown by Fig. 204. This obviates

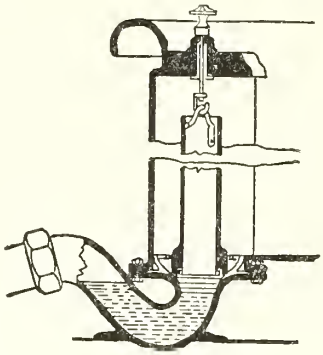


Fig. 204.

the necessity of discharging the overflow on to the lead safe, and consequent sloppy mess in the bath-room. An antisiphonage pipe should be taken off the trap and carried through the wall with a brass grid

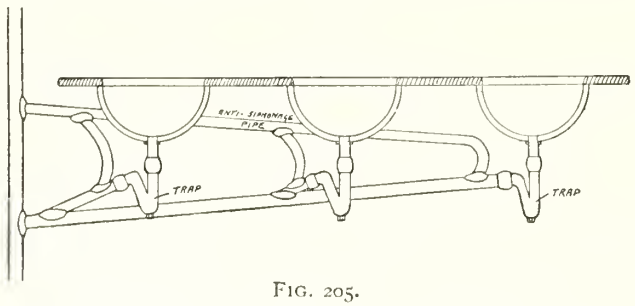


Fig. 205.

soldered into it, or it can be connected to another antisiphonage pipe, if one is near.

Most authorities make the taps to discharge above the water-line, but it is preferable to discharge them below, and prevent the room being filled with steam. The supply pipes to the bath should be $\frac{3}{4}$ inch down-stairs and 1 inch upstairs, but this greatly depends on the head and hardness of the water available. The taps should always be of the screw-down type.

Lavatories and their Wastes. — The many types of lavatories on the market can be divided into two sorts:—

(*a*) The tip-up basin.
(*b*) The ordinary basin and plug.

Many prefer the first-named, as the basin is emptied more quickly. The under basin into which the water

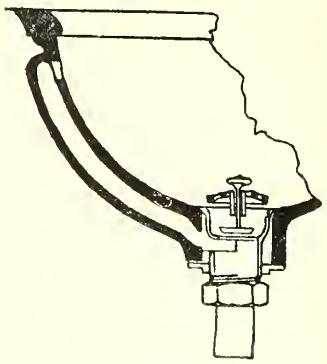


Fig. 206.

is thrown must be frequently cleansed to prevent its becoming a nuisance.

Fig. 205 shows a range of ordinary lavatory basins with their plumbing. They may be in the form as shown on Fig. 206, or with a concealed (Fig. 207) or open standing waste. Fig. 205 shows the manner in

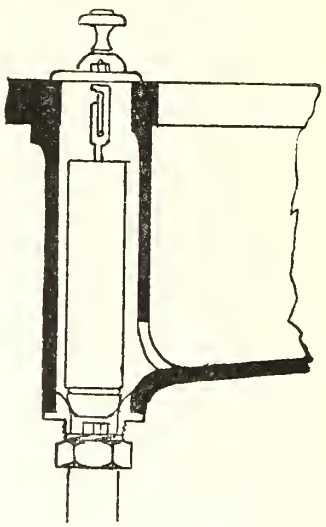


Fig. 207.

which each basin is trapped and the way the anti-siphonage pipe is arranged, the trap being of the anti-D type. The junction between the waste and the lead pipe is made by a brass cap and fly nut, as shown by Fig. 208. The lead trap is connected to the lead waste by a wiped joint.

Urinals are of two types, the lipped basin and the circular back. The lipped basin (Fig. 209) is trapped

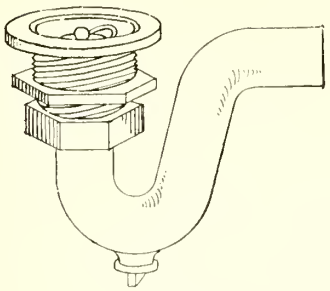


Fig. 208.

in itself, but the circular-backed (Fig. 210) discharges into a channel with a perforated grating on top, which is easily cleansed. This channel is trapped at the end

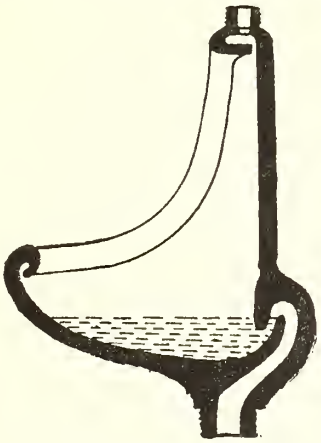


Fig. 209.

with a gulley, and the trap ventilated before its connection to the drain.

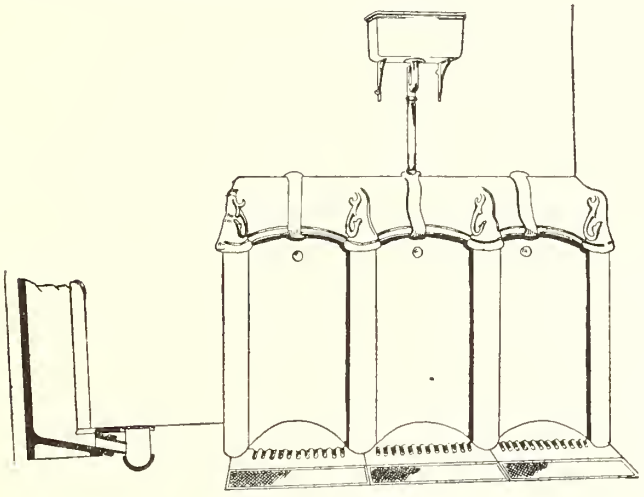


Fig. 210.

Sinks and their Wastes.—Scullery sinks are best in glazed stoneware, as York stone absorbs the grease.

They are usually about 3 feet by 2 feet, and about 2 feet 6 inches from the floor to the top edge (see Fig. 211). They may be supported on half-brick walls rendered in Portland cement, or on cast-iron brackets, or on glazed pedestals. The sink should have a good fall to the outlet, which should be arranged in the

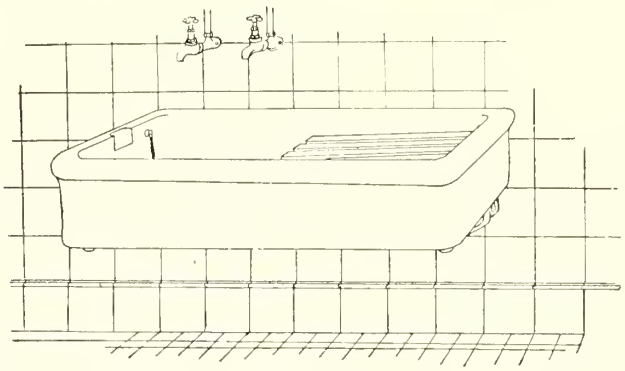


Fig. 211.

corner on the side next the outer wall. The outlet should be fitted with a $3\frac{1}{2}$-inch bell-mouthed cobweb grating, and the waste trapped with a trap at least 2 inches internal diameter, with inspection screw cap as shown in Fig. 212.

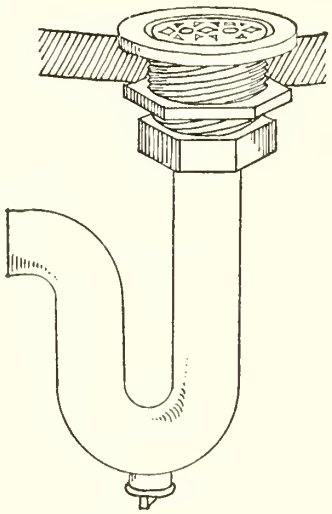


Fig. 212.

Housemaid's Sink.—This is usually in connection with the slop-sink, but it is more usual to empty the slops down the water-closet. Fig. 213 shows a Doulton's combined wash-up and slop-sink. The basin and trap are in earthenware, and there are valves for hot and cold water. The wooden grating on the wash-up side is to prevent crockery from being broken by contact with the stoneware. The trap and waste should be ventilated and connected to a soil pipe outside.

Butler's sinks are usually 15 inches deep, in lead, with 10-lb. bottom, and 7-lb. sides; the joints at the angles and bottom being made by means of welts.

They are sometimes of glazed earthenware, but breakages are then more liable to occur; others are lined

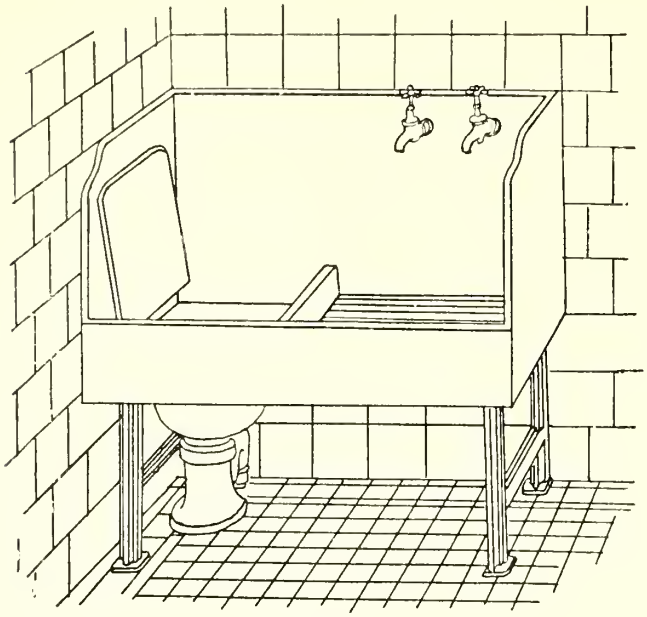


Fig. 213.

with copper or tin, the copper joints being welted. Butler's sinks should be fitted with hot and cold water,

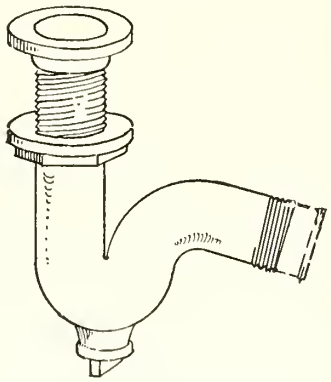


Fig. 214.

and trapped with a deep trap with inspection eye (see Fig. 214).

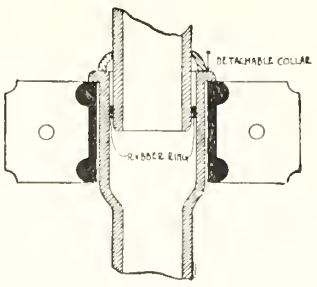
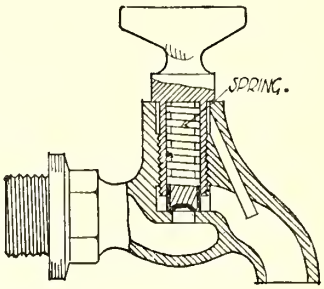


Fig. 215.

Where a large amount of hot water is used it is found that the expansion and contraction crack the joint on the lead trap. To prevent this an expansion joint, as shown by Fig. 215, is used. The expansion and contraction are taken up by a solid rubber ring passing round the outside of the upper pipe, and allowing it to move up and down. Another method is to use east-brass traps; but, although they are not liable to so great expansion and contraction, being rough inside from the core sand, they catch and retain



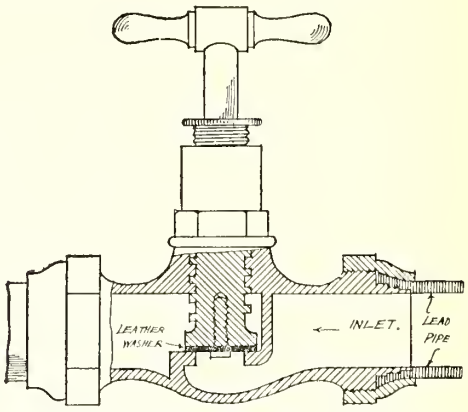
KELVIN BIB-TAP.

Fig. 216.

the grease, and are therefore not so cleanly as the lead traps.

Taps and Fittings.—The regulations of Water Companies cause these fittings to vary in different localities, so that what may be legally used in one part of the country is forbidden in another.

Fig. 216 shows a section through Lord Kelvin's bib tap. This avoids the use of washers, and the turning of the tap grinds the valve on its seating.



FITTING OF STOP-COCK TO LEAD PIPES

Fig. 217.

Fig. 217 shows a stop cock for connection to a lead pipe. It will be noticed that the joint is made by a brass-screwed collar, and not by the wiped joint as in ordinary practice.

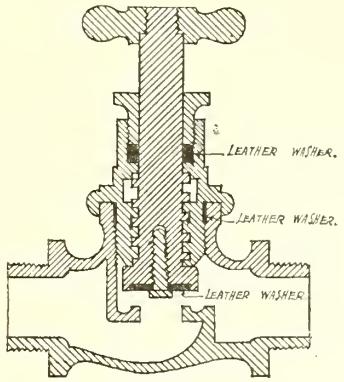
Fig. 218 shows a quick-turn full-way cock which can be used as a stop cock.

A quarter-turn bib valve is shown by Fig. 219.

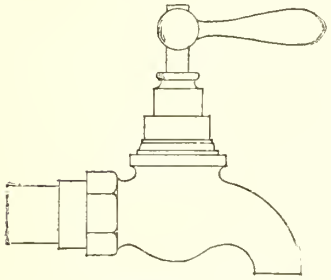
Where the pressure is low, a clear-way wheel valve

may be used, as shown by Fig. 220. This valve does not diminish the force of the flow.

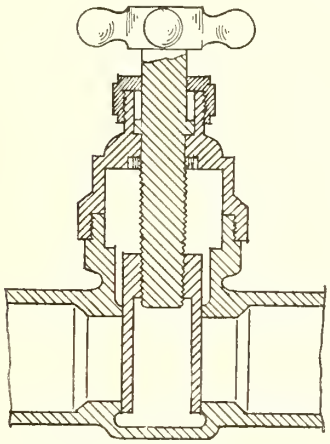
If the water supply is limited, a spring valve is used for lavatory basins, as shown by Fig. 221. It is



QUICK TURN FULL-WAY VALVE.
FIG. 218.



QUARTER TURN BIB-VALVE
FIG. 219.



CLEAR WAY WHEEL VALVE.
FIG. 220.

actuated by pressing the knob at the top, which springs back, shutting off the water when the pressure is released.

To prevent birds, dirt, etc., entering overflows, and the ingress of cold air in winter, a flap valve is used, as shown by Fig. 222.

In storage cisterns and water-waste preventers, a

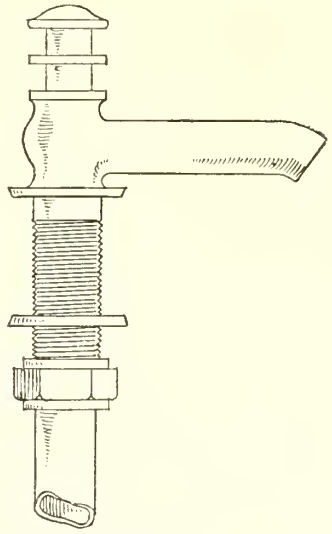


FIG. 221.

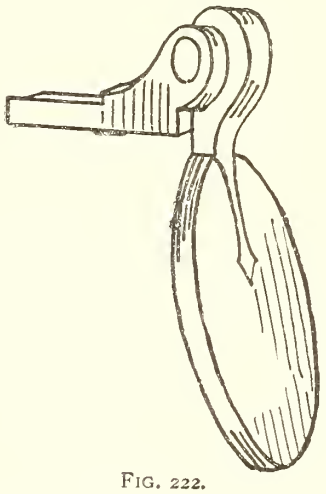


FIG. 222.

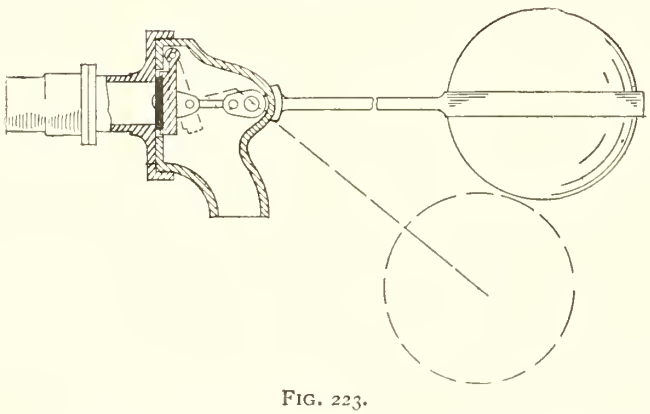


FIG. 223.

full-way ball valve, as shown on Fig. 223, is used. It permits the water free egress, and automatically closes when the tank is full.

Where quick closing taps, such as the spring valve, are used, an air chamber should always be fixed, to stop the noise made by the sudden closing of the tap. This noise is known by the name of "water-hammer," and is caused by suddenly stopping the flow of water

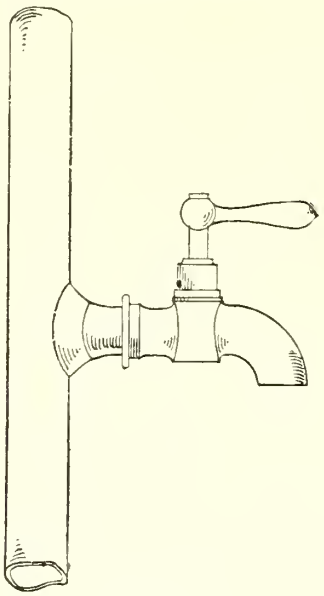


Fig. 224.

(taking place through the whole of the pipes) when a tap is closed. With a screw-down tap, however, the water is shut off gradually, and no appreciable concussion occurs. The use of an air chamber is to act as a buffer when sudden pressure is put on. Fig. 224

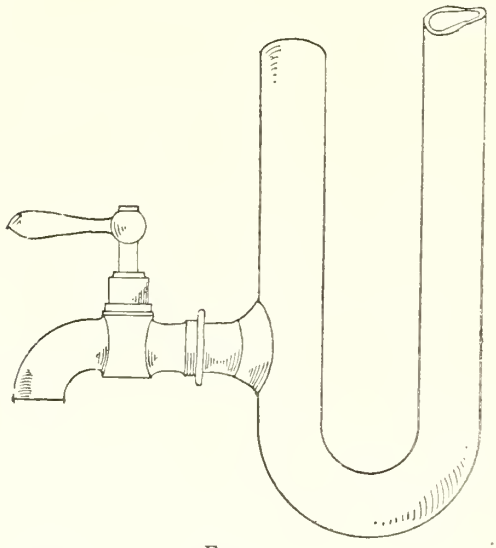


Fig. 225.

shows an air chamber on an ascending pipe, Fig. 225 on a descending pipe, and Fig. 226 when the tap is on a rising main.

Water Supply Pipes. — Too much care cannot be taken in planning the course of the pipes carrying the water supply to a house. All water mains should be at least 2 feet below the surface of the ground, and if subject to severe frosts should be laid in a wooden trough filled with "non-conducting" material.

After leaving the main, a stop cock should be fixed near the house, and in such position as to be readily accessible. It should be similar to that shown in Fig.

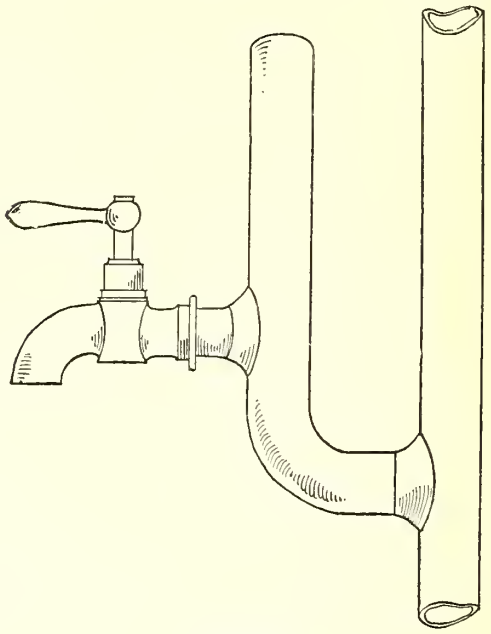


Fig. 226.

217, and covered by a stop-cock box, as shown by Fig. 227. A draw-off cock should be placed on the rising main to empty the pipes when necessary, and the rising main should be of a size that will supply the cistern as quickly as the water is drawn off, when the capacity of the cistern is not equal to the supply of all the draw-offs.

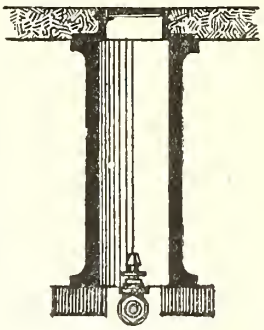


Fig. 227.

Every cistern should be provided with an overflow pipe, whose diameter should be from 25 to 50 per cent. greater than that of the supply pipe. The overflow should be taken into the open air, and fitted with a brass, or a copper flap, at the end (see Fig. 222).

Standing plugs are preferable for emptying the cisterns, and for cleansing purposes. When it is

necessary to take a supply pipe against an external wall, it should be covered with hair felt, or some other non-conducting material, and cased.

Connections with cisterns should be through the sides, and at a height from the bottom equal to the diameter of the pipe. This prevents sediment from being drawn into the pipes.

The sizes of supply pipes vary with the head of water; the greater the head, the smaller the diameter of the pipe.

A stop cock should be fixed in the main supply near the cistern, to be used in case of accident.

Table of sizes of service pipes and valves for various purposes (Hellyer): —

Head of Water, *i.e.* Height of Cistern (bottom) above Outlet.	Sizes of Pipe and Valve for flushing Rim Closets.	Sizes of Pipes for Sinks and Draw-offs.
Ft. Ft.	In. In.	In. In.
4 and under 6	$1\frac{1}{2}$-pipe and $1\frac{1}{2}$-valve	$\frac{3}{4}$ to 1
7 ,, 12	$1\frac{1}{4}$,, $1\frac{1}{2}$,,	$\frac{1}{2}$,, $\frac{3}{4}$
13 ,, 18	1 ,, $1\frac{1}{4}$,,	$\frac{1}{2}$
Above 18	1 ,, 1 ,,	$\frac{3}{8}$ to $\frac{1}{2}$

CHAPTER X

GLAZING

(Contributed by T. H. Bishop, A.R.I.B.A.)

In a variable climate such as ours it is necessary that the openings to admit light be filled with a substance which will keep out the wind, rain, etc., and let in as much light as possible. The material used in this country is glass, and the operation of fitting in the glass is called Glazing.

The majority of bye-laws in relation to building state that the window area, exclusive of the frames, must be equal to one-tenth the floor area, but no mention is made of the loss of light in passing through the glass.

The following table shows the proportion of light intercepted in passing through the different qualities of glass:—

British polished plate, $\frac{1}{4}$ inch thick .	13 per cent.
Rough cast plate, $\frac{1}{4}$ inch thick . .	30 ,,
Rough rolled, 4 flakes to 1 inch .	53 ,,
32-oz. sheet glass	22 ,,

Many makes of glass, such as brilliant, muffled, and venetian, make up for the loss by diffusion and diffraction.

The different qualities of sheet glass are distinguished by their weight in ounces per foot super.; those of rolled glass, by their thickness. A sheet of glass $\frac{1}{10}$ inch in thickness weighs about 21 oz. per foot super.

It may be noted that one-seventh of the glass used in this country is British, the rest is mainly Belgian. The latter, although attaining a high standard of excellence, is inferior to the British in clearness.

The following are the various qualities of glass principally used.

Crown Glass is finer in surface and whiter in quality than sheet glass, and is slightly convex. In fixing, the convex side should be placed outside, as each disc of glass has a bullion in the centre. The largest panes that can be obtained are about 18 inches square. It is obtainable in one thickness only, equal to about 13 oz., but the demand for it is very small.

Sheet Glass is made in various qualities (Specification):—

A, for pictures (best).
B, for pictures (ordinary).
Best, for first-class work.
Seconds, for good glazing.
Thirds, for ordinary glazing.
Fourths, for coarse glazing (little used).

Sheet glass is described in Specifications according to weight, and sheets can be obtained up to 54 by 36 inches.

Weight.	Thickness.
15 oz.	$\frac{1}{15}$ inch.
21 ,,	$\frac{1}{10}$,,
26 ,,	$\frac{1}{9}$,,
32 ,,	$\frac{1}{7}$,,

Fluted Sheet Glass is corrugated to increase its strength, and is used where privacy is required without undue obstruction of light. It is obtainable in 15, 21, 26, and 32 oz. sheets.

Patent or *Blown Plate* is sheet glass polished on both sides. In patent plate the bubbles are oval or irregular, but in the British plate they are spherical. Patent plate is particularly thin, and is used for air-tight show cases on account of its lightness.

Patent Plate Glass is obtainable in two "colours," the usual, crystal; and the extra, white. Sheets can be obtained up to 50 inches long and 39 inches wide, or 13 feet in area.

Plate Glass is made by casting on a table, and afterwards rolled. The rolling consolidates and toughens the glass.

It is manufactured in three qualities: rough plate, rolled plate, and polished plate.

Rough Plate, or *Rough Cast Plate*, is the commonest quality of glass cut into sheets. One side appears polished and the other dull, but both sides are wavy. It is used where great strength and little light are required, and is obtainable $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch in thickness, 60 feet in area up to $\frac{3}{4}$ inch thick, and 40 feet in area for 1 inch.

Patent Diamond Rolled Rough Plate, and *Patent Quarry Rolled Rough Plate* have each an oblique lozenge pattern on one side only (the pattern should be placed outside). The lozenge is larger in the latter. The quarries measure 6 by $4\frac{1}{2}$ inches and 3 by $2\frac{1}{16}$ inches. The stock thicknesses for both are $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ inch; and these can be obtained in sheets 100 feet long by 34 inches wide.

British Polished Plate is first cast on a large iron table, and then rolled by a heavy iron roller into sheets from $\frac{3}{8}$ to $\frac{1}{4}$ inch thick. It is afterwards ground down

to an even surface and uniform thickness, and polished by special machinery.

Rolled, *Rough*, *Figured*, *and Pattern Plate Glasses* are cast and then rolled to impress the pattern in the back surface of the glass.

Muranese, *Hartley's*, etc., are made in a similar manner.

The plain and fluted can be obtained $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, and $\frac{3}{8}$ inch.

The extreme sizes of plain rolled glass that can be obtained are:—

	Length.	Width.
$\frac{1}{8}$ inch . . .	120 inches.	42 inches.
$\frac{3}{16}$, $\frac{1}{4}$, and $\frac{3}{8}$ inch .	120 ,,	44 ,,

Fluted or *Ribbed Glass* is especially useful where a large amount of diffused light is required. The horizontal ribs give more light in the middle and less at the sides, whilst when placed vertically the reverse holds good. Horizontal ribs give more brilliant light than do vertical ones.

Ground or *Obscured Glass* (sheet or plate) has one side rendered opaque either by grinding the surface or by coating it with a vitrifiable matt flux. It is supplied in 15, 21, 26, and 32 oz. sheets. In fixing, care should be taken to size the edges.

Enamelled Glass is similar to ground glass, except that parts only are obscured to form a pattern. Figured rolled is rapidly superseding enamelled glass, owing to its better appearance and strength.

Another glass used largely in hotel work is *Embossed Glass*. It is made in two ways, the "sand blast" and the "acid process" (ordinary or single). The "sand blast" is the cheaper, but the "acid process" is the better. The embossing is done after the glass has been cut to shape, and any required degree of transparency or opacity can be obtained.

Coloured Glass can be obtained in sheet, muffled, rolled, or antique. It is usually $\frac{1}{8}$ inch thick, rolled or muffled. The glass is either coloured throughout, and is then known as cathedral tinted, or coloured only on the face, when it is called "flashed" glass. The term "cathedral" is also applied to unbleached or uncoloured glass.

Perforated Glass may be either "sheet" or "plate." The perforations for ventilation are cut in the glass after manufacture.

Wired Glass is made by embedding wire netting in the centre of the thickness of sheets of plate glass. It is used for glazing roof skylights and doors subject to jar or vibration.

The effect of fire is similar to that on plate glass; but, while the plate glass falls out and is dangerous, the wired glass, although cracked, remains in position. The renewals of wired glass are more expensive than those of plate.

Glass Slates and Tiles are useful where a small amount of light is required. They are made of rough rolled plate $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, and $\frac{3}{8}$ inch in thickness, and secured to the battens with wooden pegs or copper clips.

Putty is made from raw linseed oil, and whiting ground to a fine powder. The oil is added to the whiting, and the mixture kneaded into a stiff paste and left for twelve hours, when it is afterwards worked up in small pieces till quite smooth.

Where the rebate is small a little white or red lead may be added to make the putty more adhesive.

Soft putty is made as follows:—10 lbs. of whiting and 1 lb. of white lead are mixed with a half gill of the best salad oil, and an admixture of linseed oil to bring it to the proper consistency.

Thermoplastic putty is similar to that stated above, with the addition of tallow, which makes it pliable, so that it will stand the expansion of large panes of glass.

Glazing in Wood.—In glazing in wooden sashes or frames, care should be taken that the glass is cut slightly less than the distance between the rebates. These are back puttied, *i.e.* a layer of putty is spread over the narrow part of the rebate, and on this the glass is bedded. The remaining part of the rebate is stopped by a triangular piece of putty which holds the glass in position.

The waste putty squeezed out by the glass should not be cut off for at least a week after the glass has been stopped in. Large sheets should be sprigged in addition.

In the case of plate and very thick glass (with the exception of roofs and skylights) back puttying is not required.

Plate glass in doors, and other places where it is liable to concussion, is frequently bedded on vulcanised indiarubber, or washleather, one piece of which is glued to the inside of the rebate and the other placed on the reverse side of the glass. It is maintained by some that this becomes hard, owing to the weather or moisture, and that the glass cracks, but on examination it will probably be found, in such a case, that in fixing the beads a screw has been placed too near the edge of the glass, which causes it to fracture.

In large skylights where there are no transverse bars the glass has to overlap. In that case the two sheets should be hung together with copper clips. The slope of the roof will govern the lap, but as a general rule $1\frac{1}{2}$ inch will be found sufficient.

The woodwork to be glazed should be first primed to assist the adhesion of the putty (if putty is used), or the glass is secured by wood fillets in rebates without putty, and the rebates are placed inside instead of out. Brass screws and cups should be used, and a little lead putty for the bedding.

Patent Glazing.—This system of glazing without putty is now extensively used for large factory, station, and conservatory roofs. There are many systems in use at the present time, each of which claims some special advantage.

A successful system should have the following characteristics :—

1. Simplicity of construction, enabling it to be easily repaired, and broken glass replaced by ordinary workmen.

2. It should possess sufficient strength to permit of workmen crawling over it to execute repairs.

3. It should allow of the expansion and contraction of the roof (if iron) without breaking the glass.

4. The sash bars should not be so heavy as to materially obstruct the light.

5. Metal parts and fastenings should be so arranged as to protect them from corrosion from the weather.

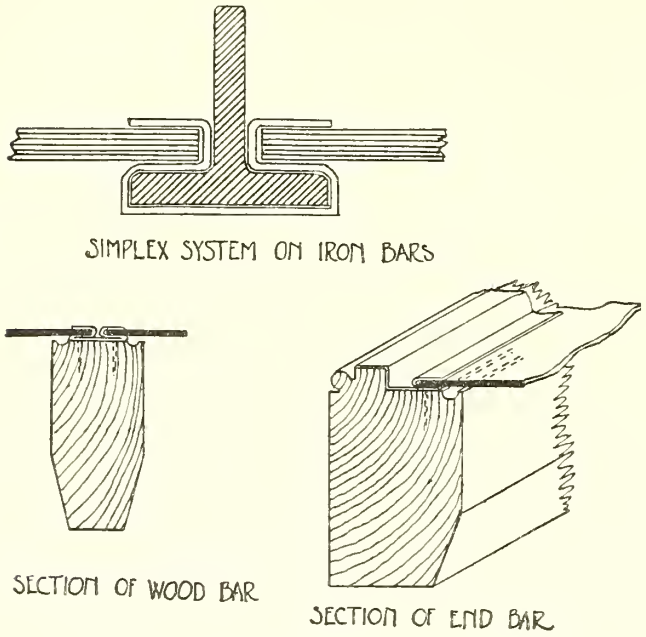


FIG. 228.

The following illustrations show some of the systems at present in use :—

Grover's.—This patent glazing is used for greenhouses, conservatories, and small skylights, and consists of fixing strips of lead nailed to wooden bars. The bars should be about 15 inches apart centre to centre, with a flat top from $1\frac{1}{2}$ to $1\frac{3}{4}$ inch wide, and grooved as shown.

The lead strips are fastened down the centre of the rafter, leaving the grooves clear, and are secured to same with $\frac{3}{4}$-inch copper tacks 8-inch pitch (4 inches apart on alternate sides of the flange). Where the glazing is on movable parts the nailing should be half that distance. For thick glass, and where the roof is steep, copper clips should be used at the foot of each pane.

Fig. 228 shows the various sections of the bars and their application and fitting.

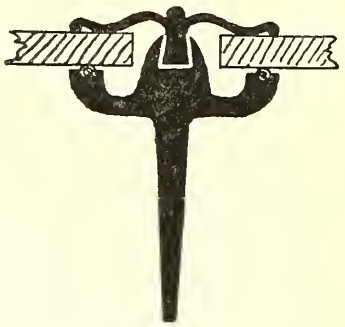


FIG. 229.

Hope's Glazing has been largely used for railway stations. Fig. 229 shows a section of the bar.

The lead is cast to the shape indicated, and fitted into the groove in the top of bar, being afterwards turned down on to the glass. It will be noticed that condensation channels of ample width are provided.

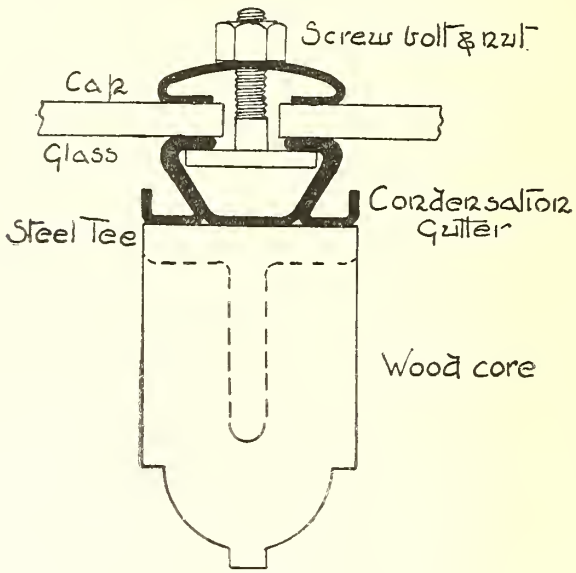


FIG. 230.

Rendle's "Invincible" Glazing has also been extensively used, especially for railway station roofs. Fig. 230 shows the method of fixing. For lengths up to 4 feet, the bar as shown in black, either in copper or zinc, can be used. For lengths above 4 feet, wood bars, or steel tees, as shown by dotted lines, must be used.

Mellowe's "Eclipse" Glazing.—Fig. 231 shows the various bars and fixings. The bars may be either of wood or steel, the fixing of the glass being a tinned

lead metal cover, soldered at both ends. It is claimed that no breakage of glass from expansion and contraction can take place.

Fire-Resisting Glazing.—The Luxfer Prism Syndicate Ltd. have introduced a fire-resisting glazing, by means of a patent process of mounting or uniting glass by copper electrically deposited. The glass is assembled on a table with copper ribbons until a plate of required size is built up. This is then put into an electrolytic bath, and copper is deposited over the edges of the glass. This deposited metal is so intimately connected with the edges of the glass that glass and copper become practically welded together. It has been tested by the British Fire Prevention Committee up to 1000° Fahr., when 317 squares out of 324 withstood the action of fire and water.

Leaded Lights.—Panels composed of pieces of glass leaded together are termed leaded lights, and may be either of plain, coloured, or mixed glass.

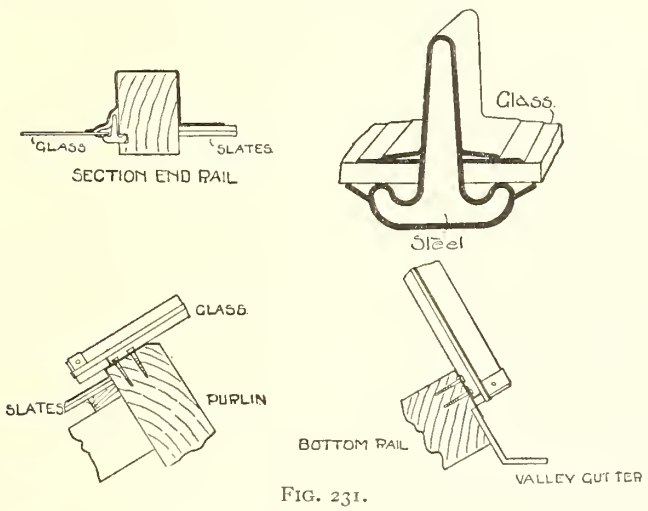


FIG. 231.

The leads should be pure vice drawn, with soldered joints. The lead is first cast in short cames, and then put through a compression vice to reduce it to the required size, polish and harden the surface, and mills the heart of the lead, so that it holds the cement and glass firmly. The compression of the lead protects it from the weather. Leads drawn in a molten state are softer than those compressed in a vice, rougher and less homogeneous, and rapidly corrode.

The leads or "cames" are of an H section, the stout middle portion being called the heart and the sides the leaf. The leaf may be from $\frac{1}{8}$ to 1 inch in breadth, the heart being stout in proportion. For general external glazing, the leaf should be from $\frac{1}{4}$ to $\frac{1}{2}$ inch wide. Cames are made of many gauges to suit different thicknesses of glass.

There are three forms of leaf: flat, round, and beaded edge. Of the three, the beaded edge is preferable for general work, as it is more water-tight, whilst the broader leads are used for the outside margins, and should fill the rebate and project $\frac{1}{8}$ inch beyond.

Plain square lead glazing should be arranged in panes not less than 7 by 5 inches, with leads $\frac{7}{16}$ inch wide.

Decorative Glazing.—When glass is inserted in windows for the purpose of creating decorative effects, rather than for giving light, the method of its insertion is much the same as for plain lead glazing, which has just been mentioned. The glass is cut to such shapes as are necessitated by the pattern, and is enclosed in the cames, which are soldered together where they meet, so that the whole is built up into a framework, and itself enclosed in an outline of lead came. It is usual to build up a window in this way in sections, which are slipped one by one into grooves formed in the masonry outline of the window, where they are afterwards cemented in. The sections are also soldered together, and attached to the saddle bars as afterwards mentioned. The fixing can, however, in smaller windows be made more satisfactory by means of a wood frame, a small bead or fillet being screwed on to the outside, so that there is no necessity for slipping into a groove, with the resulting vacant space to be filled with cement. After the glass is inserted, and at least a week before fixing, the cames are carefully cemented by brushing under the leafs a cement composed of oil mastic, or whiting and red lead, the leads being afterwards coated with blacklead so as to ensure their being water-tight. For the sake of strength and water-tightness, the glass should fit accurately to the heart of the cames, which can only be done with great care; but a window built up in this fashion is necessarily composed of quite small pieces of glass, and as a natural result it is structurally weak, and liable to be blown in during a gale of any strength. In order to prevent this the windows are stiffened by means of iron or copper "saddle bars," as they are called, passing across the window from side to side at intervals of about 18 inches, and, if necessary,—that is, if the window be more than 30 inches wide vertically,—from top to bottom. These are usually placed outside the window, but not necessarily so, for sometimes they are found inside, and sometimes on both sides. As a rule they are straight, but this is not essential, and in fact it is by no means uncommon to bend them to the shape of a head, or other object in the design. The windows are attached to these saddle bars by means of copper wire soldered to the cames and twisted round the bars; and the different sections of a large window are made to space with the saddle bars, upper and lower sections being in this way attached to the same bar.

It will thus be seen that all ornamental glazing is limited, in the matter of design, by the presence of these stiffening bars, and by the necessarily small pieces of glass which are used. These, however, can be cut to any required shape, though it must be remembered that when a window bulges under the force of a gale, it is the awkwardly shaped piece of glass which will first break. The design, therefore, is controlled by the fact

that there must be strong outlines of lead appearing across and across it in all directions.

A further controlling influence is the nature of the glass which can be used. At the present time we have many good varieties of white and coloured glass, the coloured glass of a single tint being known as "pot metal," and being made by mixing various metallic oxides with the material of which the glass is composed. This is obtainable either in flat or graded tints.

Painted Glass is quite a different thing. It consists of a light pot metal, upon which paint has been applied, which itself consists of oxides mixed with powdered glass and some form of gum to make it adhere. The sheet upon which it is applied is placed in the furnace a second time, and heated to a red heat, when the paint is absorbed into the surface of the original glass and henceforth forms part of it. The paint is, as a rule, applied by means of brushes of a stiff kind, somewhat as in oil painting on canvas ; but there is another form of tinting glass, known as *Grisaille*, which consists in laying the colour in thin lines across and across the surface to be tinted, so as to allow a considerable amount of light to pass in through the meshes. Deep tones of simple colours are not always obtained by selecting a deeply coloured glass, but often by introducing two or three sheets at a particular spot, using, of course, a thicker came for the purpose.

It is not the intention in this book to go much into matters of taste or of design, and the illustrations have consequently been chosen mainly for constructional reasons. Fig. 232, for instance, represents a long

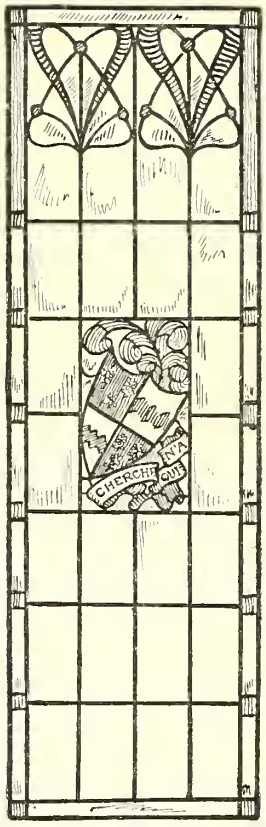


Fig. 232.

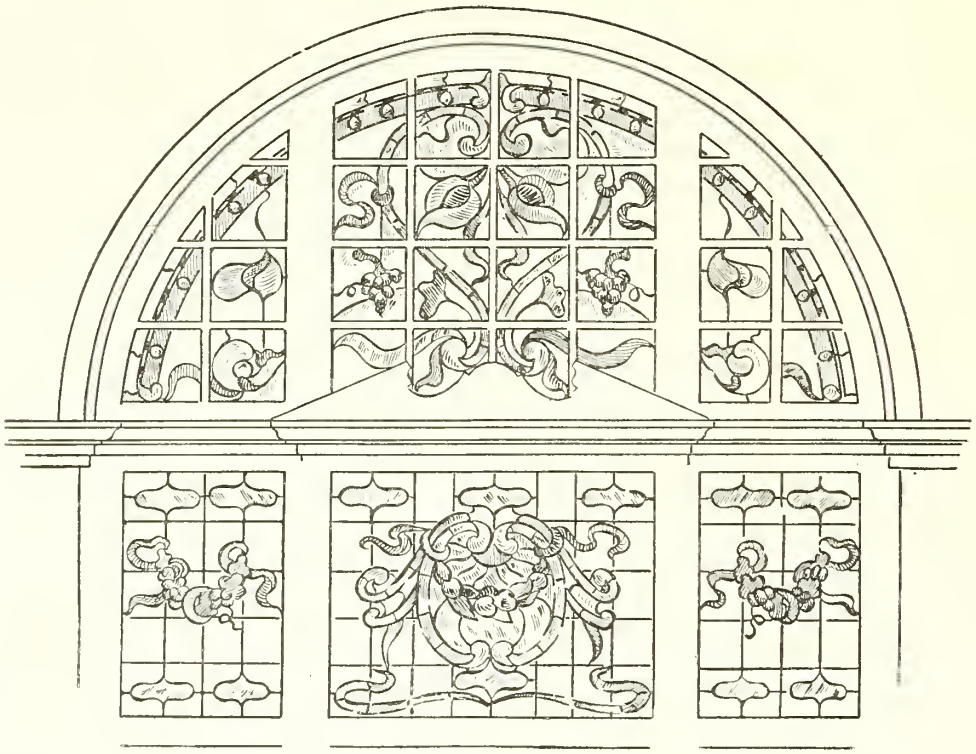


Fig. 233.

PLATE VI

EAST WINDOW, CHURCH OF ST. MATTHIAS, BARBADOS

By CAKEBREAD, ROBEY & CO., 86 *High Street, Stoke Newington, London, N.*

narrow panel such as could be easily built up, the saddle bars, if any, occurring above and below the coat of arms, which has been designed to occupy a rectangular panel.

Fig. 233 illustrates a large window, made by Messrs. Cakebread, Robey, & Co., for a wood frame, mostly in small squares, needing no support, though the middle panel at the bottom would be the better for one vertical stay bar. Its presence, as a shadow on the glass, would not materially interfere with the symmetrical design.

Fig. 234 shows ornamental glazing as applied to an ordinary sash window, for execution in carefully selected pot-metal only, not uniformly tinted in each piece, but chosen for its markings. It will be seen that in each sash there is a nearly horizontal line of leading right across, which a saddle bar could follow with a small amount of bending.

Plate VI. is a small example of what can be done with lead glazing in painted glass. It represents a window carried out by Messrs. Cakebread, Robey, & Co., of Stoke Newington, and erected in a church in Barbados. The sky and some portions of the border are in pot-metal, but most of it is in tinted glass carefully painted. The leading is carefully devised so as to accentuate the design, which might otherwise be easily broken up and spoilt—and the saddle bars follow the leading, one, for instance, passing over and round all three heads in the middle light.

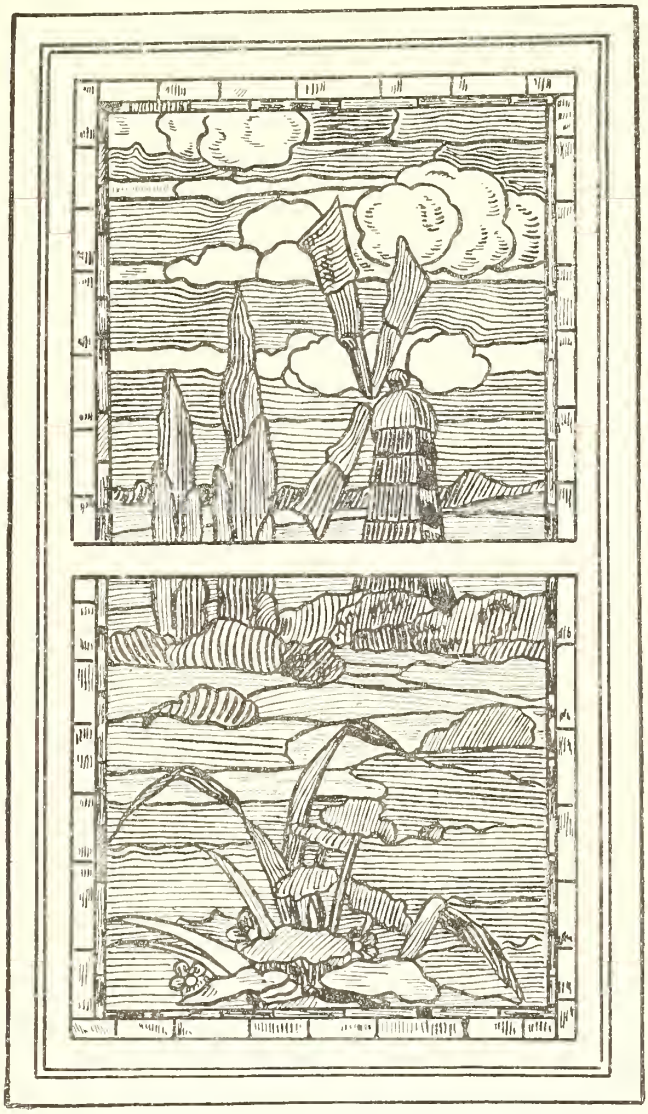


FIG. 234.

CHAPTER XI

FLOOR PAVING AND WALL LINING

THERE is one great practical essential in securing good decorative work on floors and walls, and that is, that the foundation should be thoroughly sound. In floors, a good base of rubble and cement, or a level bed of concrete finished with a thin coating of first-rate Portland cement is the best foundation. This should be brought to within $\frac{3}{4}$ of an inch of the finished floor level for tiles, and to within $\frac{1}{2}$ or $\frac{5}{8}$ of an inch for mosaic. The concrete should be about 3 inches thick, and composed of one part of cement, two parts of clean sharp sand, and two parts of gravel or other hard substance, such as marble, granite, or stone chippings. These should be thoroughly mixed with water to form a hard solid mass when beaten down into a bed.

The following notes upon foundations are from the

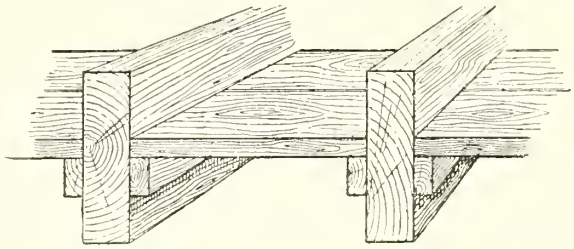


FIG. 235.

Introduction to the pattern book of Messrs. Pilkington & Co., of Clifton Junction, Manchester.

"A good foundation may also be made by laying an even bed of bricks, solidly embedded and finished with a cement coating $\frac{3}{4}$ inch thick.

"If the tile or mosaic pavement is to take the place of an old stone flagged floor, the flags will make a splendid foundation when lowered to the necessary depth, and properly embedded and then coated with cement in the usual way. If it is proposed to lay a tile floor in place of a wood floor, this can be done by taking up the old floor boards and sawing them into lengths equal to distance between joists. Fillets should then be well nailed to joists, about 3 or 4 inches from the top. Upon these fillets the short lengths of floor boards should be securely fastened, spacing them at least $\frac{1}{8}$ inch apart, to allow for any swelling which might take place (see Fig. 235). If convenient, it is recommended to cover the boards with a layer of heavy tar paper. This will, in a great measure, protect the boards from the concrete moisture, and also prevent any water from dripping through to the ceiling below. This being done, the concrete may be put in and brought level with the top of the joists, and then finished with the usual cement coating (see A, Fig. 202). If tops of

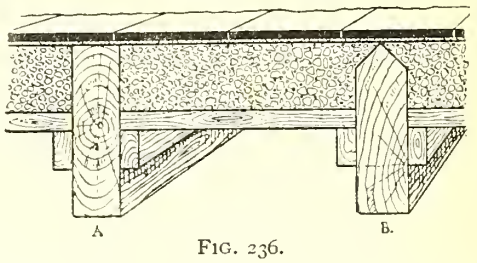


FIG. 236.

joists are chamfered, as shown at B in Fig. 236, or even roughed with a hatchet, a still better foundation is secured, and if the thickness of the old boards which

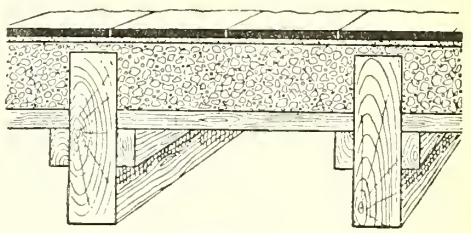


FIG. 237.

the tiles have to replace is $1\frac{1}{4}$ or $1\frac{1}{2}$ inch, so much the better, as this will allow for the intervention of about $\frac{3}{4}$ inch of bed between top of joists and tile

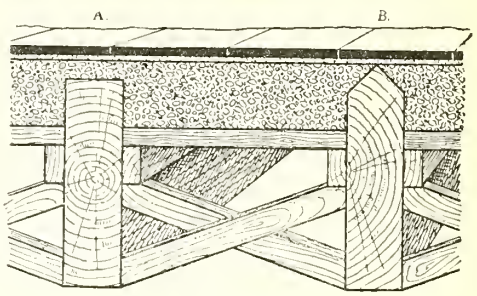
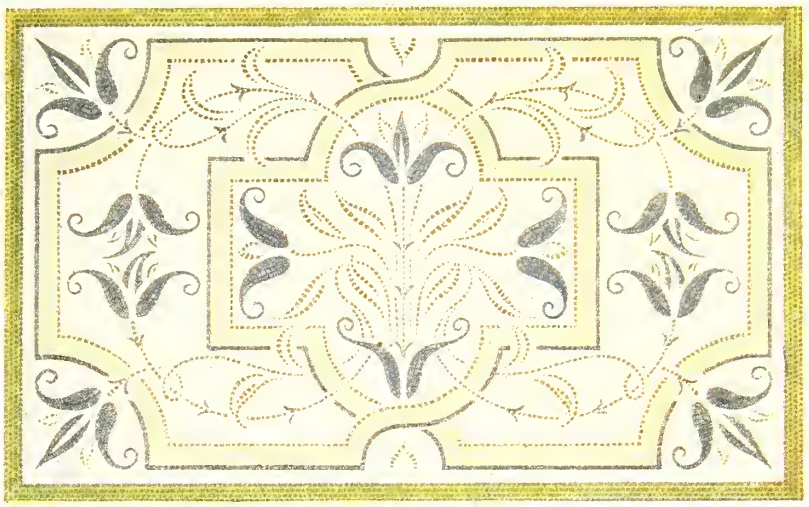


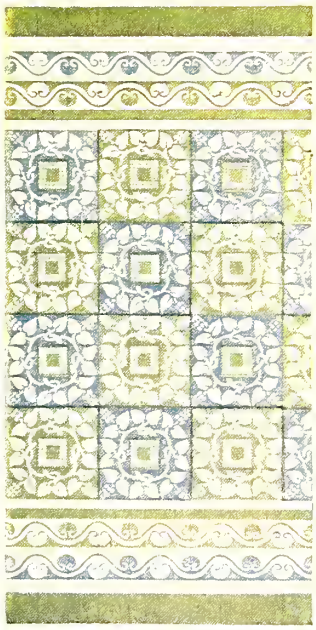
FIG. 238.

pavement, ensuring a better foundation (see Fig. 237). In such a case it will not be necessary to chamfer tops of joists, but we recommend that they should be roughed.

"If joists are of sufficient depth to allow of bridging them, this should be done, and when the strength of

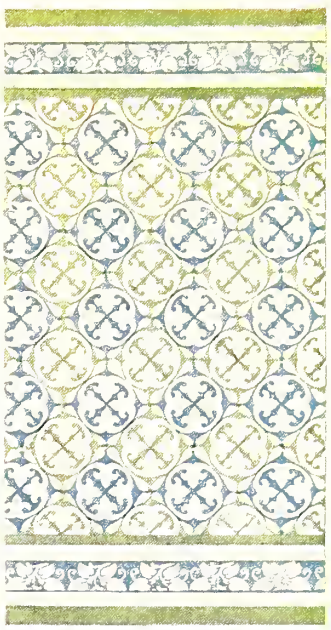


Mosaic Tile Floor



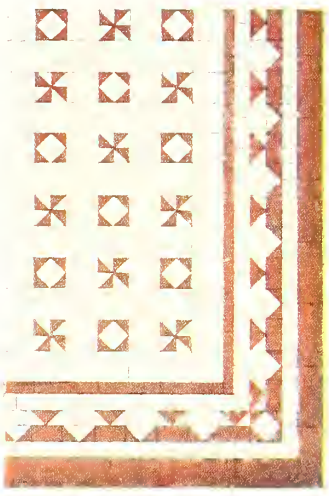
Inlaid Tiles

Decorative Wall Tiling



Inlaid Tiles

Plain Tiles



Plain Tiles

SUGGESTIONS FOR ORNAMENTAL TILES BY THE PILKINGTON TILE & POTTERY CO.

PLATE VII

joists will permit, in cases where the old floor boards are only about $\frac{7}{8}$ inch or 1 inch thick, it is advisable to cut about an inch off the tops of joists so as to get a complete concrete bed (see A, Fig. 238), or, as an alternative, chamfer tops of joists (as shown at B, Fig. 238).

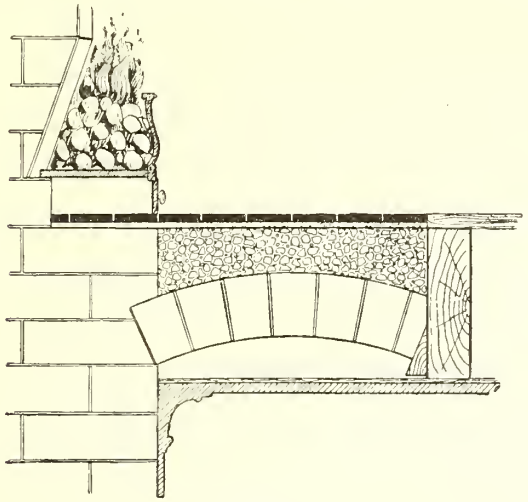


Fig. 239.

"The foundation for hearths should be of the best concrete upon brick arches, as illustrated in Fig. 239. If this is impracticable, then a sub-foundation of wood may be fixed and concreted upon (see Fig. 240). In this case the concrete should have a thickness of not less than 6 inches if possible, as a safeguard against fire.

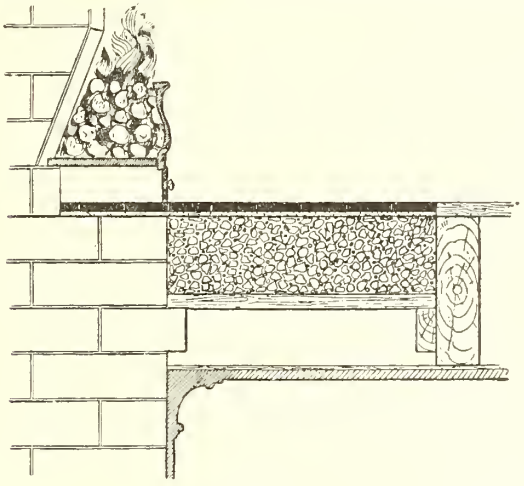


Fig. 240.

Another way, and a good one, is to have a strong angular sheet-iron sub-foundation, as illustrated in Fig. 241.

"It should be remembered that tiles and mosaic must never be fixed on boarded floors, unless there is at least 3 to 4 inches of concrete between the boards and tile floor, or the tiles will certainly become loose sooner or later, this depending only on the amount of traffic over the floor.

"Cinders or lime mortar must never be used in foundation work, or very serious trouble will almost certainly result, as the presence of either of these substances will sometimes cause the whole floor to 'lift' or 'heave.'

"When it is intended to have a sunk mat space in a tile or mosaic floor, the mat well should be surrounded with a $\frac{1}{4}$-inch angle iron frame, securelyfastened into the concrete bed ; or better still, it may have stone, slate, or marble kerb about 2 or 3 inches wide and $1\frac{1}{2}$ inch thick.

"It is usual to fix perfectly plain tiles into mat wells. Correct sizes and position of these spaces should always be marked on plan.

"Where spaces to be tiled are intercepted by steps, the positions and sizes must be shown on plan.

"If the treads and risers have to be tiled, there must be a stone, slate, or marble nosing provided for

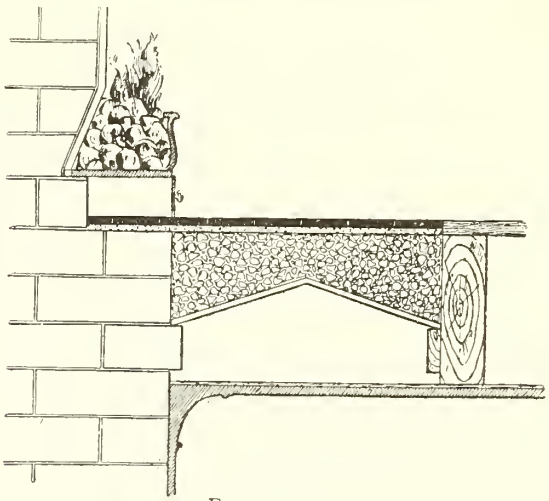


Fig. 241.

the tiling to finish against. This may be carried out in various ways.

"There are three good methods of tiling steps placed in order of merit in Fig. 242.

"If it is intended to tile the risers only, this may be satisfactorily done by either of the methods illustrated in Fig. 243.

"If the treads only have to be tiled there are two good ways of doing this, as in Fig. 244.

"No one should be allowed to walk over the floor before it is thoroughly set, which will take several days.

"If, after the floor tiles are fixed and set, any plastering, painting, or paperhanging has to be done, the tiles should be covered with plenty of sawdust, and if it is absolutely necessary to use the floor before it has had sufficient time to firmly set, which will be 3 or 4 days at least, then, in addition to the layer of sawdust, the floor must be covered with boards.

For a short time after the floor is finished a saline scum from the cement will probably appear on the

surface of the tiles. This can be removed by frequently washing the tiles in the ordinary way with soft soap and cold soft water, which should be perfectly clean. This will not only remove the scum, but enhance the appearance of the pavement generally.

"If there should be any stains or dirt which the application of soap and water will not remove, then use a solution of one part muriatic acid (spirits of salts) and six parts water. This should only be allowed to remain on the tiles a few minutes and then thoroughly washed off.

"Dilute muriatic acid may also be applied by means of a pumice stone to remove stains, etc.

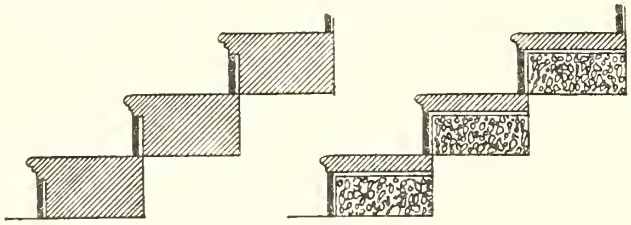


FIG. 243.

"Too much water must not be used in washing the floor.

"The scouring of tile floors with sand will remove the grouting from the joints and spoil the appearance of the floor.

"In every case after washing the floor should be wiped with a clean dry cloth.

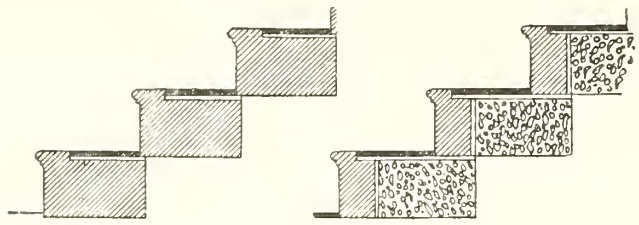


FIG. 244.

"PREPARATION OF WALLS. — All walls which have to be tiled must be rendered with cement.

"In the case of new walls the brick joints should not be pointed but left rough.

"They should also be raked and brushed out to secure a good key for cement rendering.

"After thoroughly wetting the walls, the cement mortar, composed of one part best Portland cement and two parts washed sand, should be spread over them to a thickness of about $\frac{1}{2}$ inch, or more if necessary, to make the rendering plumb.

"The face of the rendering must be well roughed or scratched to act as a key to the cement used when fixing the tiles. The rendering, which must be brought

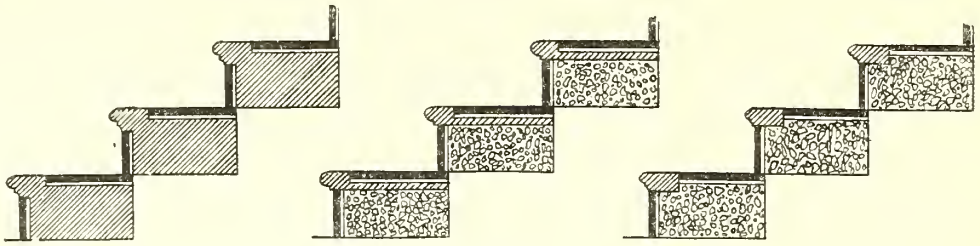


FIG. 242.

to within $\frac{5}{8}$ inch of the proposed finished tile surface, must be allowed to harden before commencing to fix the tiles.

"When old walls have to be tiled all the plaster must be hacked off first, the mortar carefully raked out of the joints, the latter brushed clean, and the walls then rendered as above explained.

"If studded walls have to be tiled the spaces between the studding should be filled in with bricks properly built on edge, and the face of studding should be well nailed with lath or other broad-headed nails, for keying purposes, previous to rendering same. The bricks may be left out if extra studding is put in and thoroughly bridged, to prevent as far as possible any springing. The studding should then be covered with sheet or expanded metal lathing, and then prepared in the same manner as ordinary walls. In this case, however, hair may, with advantage, be mixed with the cement rendering. This will help the cement to adhere better to the lathing.

"Lime mortar must never be used on walls which have to be tiled.

"The preparation of walls and floors is usually done by plasterers, but only those who have had experience in cement screeding should be allowed to do this work.

"Tiles should never be fixed in contact with wood or plaster.

"When fixtures of any kind are to be placed against the tile work, such as lavatory and bathroom fittings, provision must be made for them by fastening wood strips or putting wood plugs into the walls before the screeding is done.

"The wood strips or face of plugs to be level with face of screeding. The tiles can then be fixed over them, and when thoroughly set holes can be drilled or bored through the tiles for fastening the fixtures without injury to tiling if it is carefully done. Of course it is of the utmost importance that the strips or plugs be fixed in exact positions."

With regard to encaustic or tessellated tiling, where

geometrical patterns are used, it is essential to have the diagonals accurate and true. With this end in view the sizing of the various coloured tiles is a great consideration. Different colours have different shrinkages in the burning process. Thus a black tile, nominally 6 inches square, may be slightly smaller than a red tile of apparently similar size, yellow and grey tiles differing from both. To remedy these defects, so fatal in a tile floor, all manufacturers pass the tile through a gauge specially made for the purpose. These are known as grades A, B, and C. It is useless to attempt true geometrical work with tiles of different gauges, for it is natural that unequally sized tiles produce unequally sized joints, however artfully a fixer may manipulate the lines.

The principal tiles used for flooring purposes are either plain or encaustic, the latter having the pattern

Fig. 245.

on the same plane as the general surface of the tile, but set into it, as a species of clay inlay, before firing. The colours of plain tiles, as well as their sizes and shapes, vary to a considerable extent, and can be made up into an almost unlimited number of geometric patterns. As a general rule it will be found that the more simple the pattern for the general mass of the floor the better, diagonal and chess-board patterns being particularly objectionable, but a certain amount of richness is permissible in the borders. Rich panels of encaustic patterns may, however, be introduced, particularly in public buildings, and the chancels of churches, for which they have been used from time immemorial, usually with a red ground and yellow pattern, neither colour being too pronounced. A good example of an encaustic tile panel of this sort is given in Fig. 245, in which the red is shown in black and the yellow pattern in white, while examples of tiling, as applied both to floors and walls, are shown in Plate VII., which illustrates a series of designs by Messrs. Pilkington & Co.

There are two methods of laying mosaic, known as the Italian and the Roman methods. The Italian method consists of building up the design in sections on strips of paper, each cube of coloured marble or glass being gummed in its correct place, face downwards, as part of the design. The whole is then reversed on to the prepared bed of cement, and the paper removed and grout run into the interstices and smoothed up.

The Roman process is to press each cube in its proper position by hand into the mastic. It gives far greater scope to the artisan who is skilled and artistic by nature or training, and is costly, but it is also eminently satisfactory.

There are several materials which can be used for mosaic. Those most commonly employed being small cubes of marble or glass. Marble mosaic is generally used on floors and brought to a perfectly smooth surface, while glass mosaic is more employed on walls and ceilings, the glass being made in thick sheets by casting, and then broken up into cubes, the fractured surface being exposed in preference to the face, excepting in the case of gold and silver, which are sandwiched between two films of glass. The glass cubes are much better if they are not regular, either in shape or size, so as to catch and reflect the light in all directions, and they can be made in an infinite variety of rich colour. An illustration of this is given in Plate VIII., which represents a glass mosaic panel in St. Alban's Church, Streatham Park, designed and executed by Messrs. J. Powell & Sons, of Whitefriars, E.C.

In preparing the walls for mosaic one of the best systems at present developed is that of Mr. J. Bridge, of Mitcham, which is based upon the old Italian methods. The walls are first prepared with several washes of oil, but they may not absorb moisture from the mastic into which the glass fragments are embedded. This mastic is prepared from putty, specially modified by various ingredients, and after it has been laid on the required design is traced upon it by a pricking process, and lightly sketched in. The glass fragments are then pressed into the mastic, which shows between the joints. The process is now being used in the new Roman Catholic Cathedral at Westminster with good effect.

It is quite possible to combine in one design both marble and glass mosaic, and even mother-of-pearl and other substances may be introduced occasionally. A panel may also be built up with the figure subjects painted upon opaque glass tile, and the background formed in mosaic, the "tiles" in such a case being irregular in shape, like the sections of stained glass in a window. This work, known as "Opus sedile," is now deservedly popular, admirable opalescent effects being possible in it.

Imitation mosaic pavements can be made by casting marble chippings, with a cement backing, in square

moulds, and laying them as tiles ; while a form of flooring called "terazzo" consists of marble chippings spread on a cement bed and rolled in, being worked by hand at the various angles to produce the necessary finish, while borders are formed by rules marked round the required space. Patterns can be worked by inlaying a template of wood, cut to the shape of the ornament and removed as soon as the body of the terazzo has been laid, the space being afterwards filled in or inlaid with coloured terazzo after the ground has properly set.

There are several more modern and economical forms of wall linings, but they are rarely used in high-class work. The chief of these are those known under the names of opalite, muralite, etc. These are thin sheets of opaque-coloured glass, forming a veneer on the wall. It is possible by means of them to obtain beautiful effects, but as a rule their use is limited to the bathrooms of ordinary houses, and to butchers' and fishmongers' shops. Extreme care must be taken to form an absolutely level surface upon which they can be laid, as otherwise the glass will star or come away from the cement by which it is fixed ; but in all cases the glass is so thin that it takes comparatively little to damage it.

Quite recently metal sheets have been introduced with the same object, enamelled to represent tiles, for which they form a cheap substitute, useful in temporary structures.

It is perhaps somewhat beyond the scope of the present book to go into the question of suitable colouring and decorative forms. This must depend to a very large extent upon the taste of the designer, but the careful selection both of pattern and colour before the work is commenced cannot be too strongly advocated. This should be done on the spot, the whole scheme of a room or hall being considered at the same time and not worked out piecemeal. It is quite possible to place a floor in the hands of one manufacturer, with the wall-lining, the ceiling, and the decorative painting each given to different men instructed at different times—with the result that, while each produces first-rate work, the whole effect is most inharmonious.

PLATE VIII

MOSAIC DECORATION, ST. ALBANS CHURCH, STREATHAM PARK, S.W.

Designed and Executed by Messrs. JAS. POWELL & SONS, *Whitefriars Glass Works, E.C.*

CHAPTER XII

BELLS AND BELL-HANGING

(*Contributed by H. V. Margary*)

The bells used in modern buildings are of three kinds—1. Mechanical Bells; 2. Electric Bells; 3. Pneumatic Bells.

1. Mechanical Bells.—These bells are still used to a considerable extent, and for small houses are indeed most reliable. When properly constructed they require far less attention than either electric or pneumatic bells. The inferior fittings frequently used for mechanical bells have done much to bring them into bad repute,

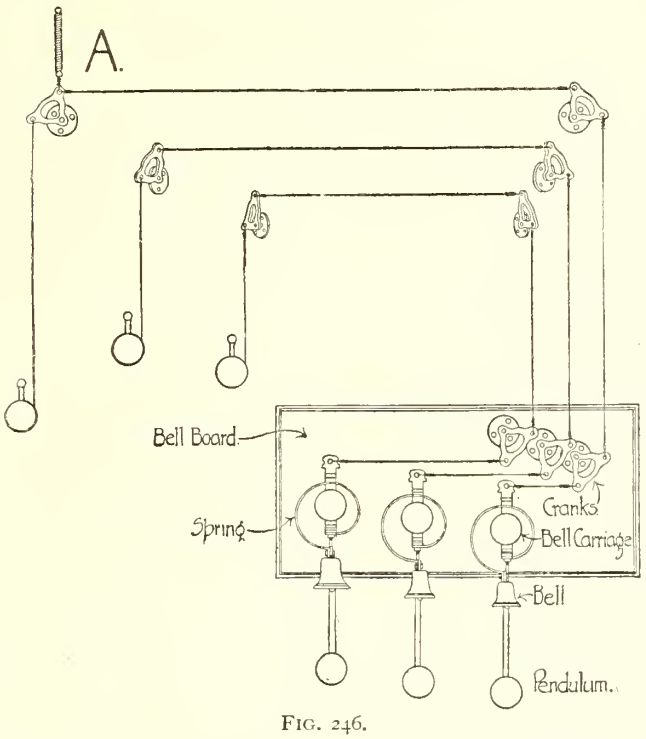


Fig. 246.

and if this point is attended to in the first place the bells will remain in good condition for years.

Another distinct point in favour of mechanical bells is that they rarely break down without giving warning by the wires becoming slack.

Fig. 246 shows a small system of bells of the mechanical type, illustrating the method of carrying the wires round angles by means of cranks.

Pulls.—Fig. 247 illustrates a few of the types of pulls or appliances fixed in apartments from which it is required to ring. The *Bell-lever* is that most frequently used for sitting-rooms. This consists of a lever, kept in a vertical position by means of a steel helical spring. When the lever is pulled down it causes a drum to revolve, winding up a chain, and thus imparting a direct pull upon the wire connecting the chain to the bell. The *Pendent*, *Sunk-bell*, *and Bell-slide* pulls are of the type used for signalling from without an entrance door, their action being too simple to need explanation here; while the *Rose-purchase-crank* pull is frequently used in bedrooms. It is also known as the *purchase-crank and tassel* pull.

Wires.—Drawn copper wire is used for mechanical bells from No. 16 to No. 19 B.W.G. It should be thoroughly stretched before use to prevent subsequent elongation, and should be so fixed that it may be quite taut between the cranks.

In cheap work the lengths of wire are passed through wire staples varying from $\frac{3}{4}$ to $1\frac{1}{2}$ inches in length, driven into any convenient woodwork.

When wires are carried beneath floors the floor boards immediately over them should be fixed with screws, so that they can be removed at any time for repairs.

Tubing.—In good work all the wires should be carried in stout tubes of galvanised iron, brass, or copper concealed in the walls. Zinc tubing is sometimes used for the same purpose, but this material is not to be recommended, as both the wire and tube rapidly decay in the presence of any moisture, owing to the galvanic action that is set up between the two metals.

Great care should be taken to fix the tubes in the direction of the pull upon the wires they contain, and, when built up of several pieces, that the pieces are in true alignment, so that there may be no friction on the insides of the tubes. The ends of the tubes are frequently filed smooth or bossed out to a slightly larger diameter to prevent the wire from chafing upon them.

Cranks.—The direction of pull of the various wires is diverted by means of cranks, several types of which are shown in Fig. 248. When wires penetrate the walls the mortise crank is used, attached to a wrought board for appearance sake.

Wheels and Chains.—In good work it is very much better to use wheels and chains, as shown in Fig. 249, for diverting the direction of pull upon the wires. These should always be employed when the wires are carried in tubes, as the direction of the pull is always the same, thus preventing undue friction of the wires over the tube. For pulling round oblique or obtuse angles also, wheels and chains are more suitable than cranks.

The wheels and chains should be of good quality, with steel chains, brass wheels, and steel axles, otherwise they rapidly deteriorate and break.

Bell Board.—This is a wrought board, 11 by 1½ inches or 11 by 1 inches, usually moulded on the edges, painted, stained, or finished in any other way according to the quality of the work. This board is screwed to plugs driven into a wall in any convenient position where the bells are required to ring.

To this board all the bell wires are brought, as shown in Fig. 246. It will be found that in most houses many of the bells will have to pass round so many corners that a large number of cranks will have to be used, and a considerable effort will be required to make the bell ring. It will then usually be more convenient to carry the wires direct from every pull to the roof, and then to concentrate them by the use of cranks, or wheels and chains, fixed to any convenient woodwork, and to bring all the wires down close together against the wall upon which it is proposed to fix the bell board, where they are attached to cranks fixed on its face.

Bell Carriages.—The bells are hung upon springs attached to brass bell carriages, as shown in Figs. 249 and 250.

Springs.—The object of hanging the bells on to springs is to cause them to continue ringing for some time after the wire has been pulled. These springs are made of steel with an oxidised surface, bent to scrolls of one or two convolutions, and varying from 4 to 5 inches across.

Bells.—The bells are cast of an alloy of one part of pure tin and three or four parts of copper. Good quality bells are turned in a lathe after casting, and are lacquered to prevent corrosion. They should vary in their sound, so as to indicate from which apartment they are rung. Bells are usually specified by weight, and vary from 14 oz. to 2 lbs. each.

Pendulums.—When there are a great number of bells, pendulums are attached to the bell carriages, and these continue vibrating some time after the bell has ceased to ring, so as to indicate which bell has rung, the name

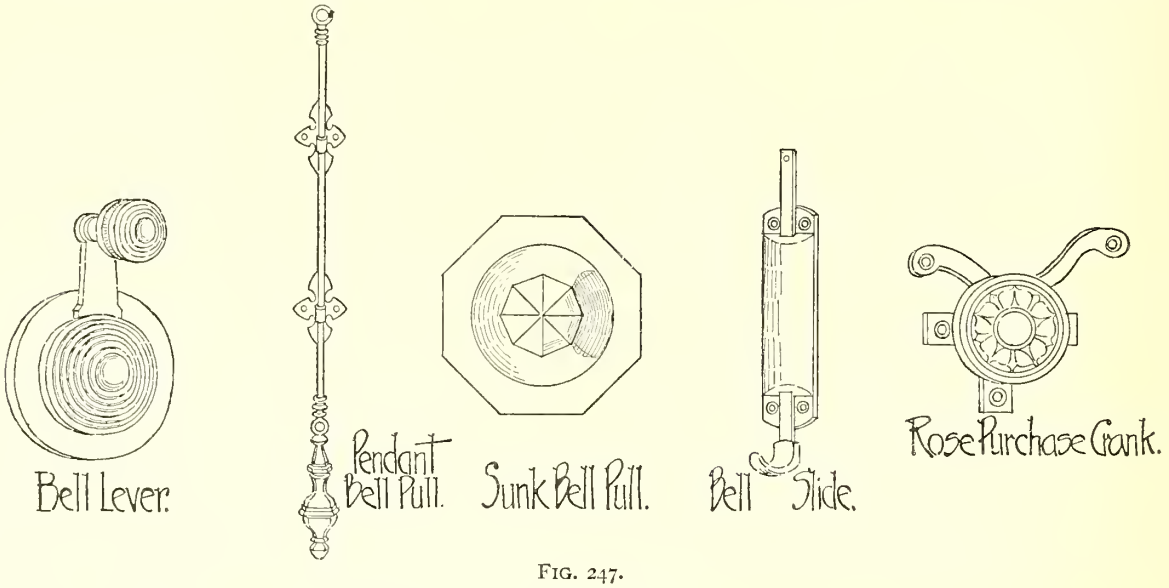


Fig. 247.

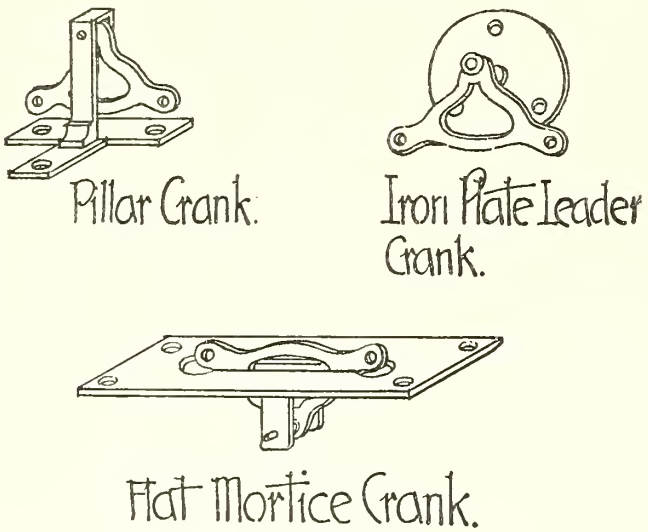


Fig. 248.

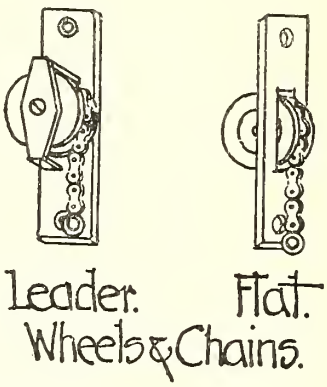


Fig. 249.

of the apartments being painted upon the bell board near the bells or upon the pendulum balls.

Check Springs.—Spiral springs of copper-covered steel are sometimes used, attached to one arm of some of the cranks, as shown at A, Fig. 246, to keep

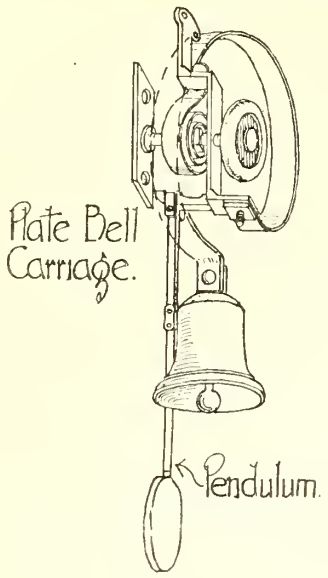


Fig. 250.

them in position when the wires have stretched, and to give elasticity to the pull.

2. Electric Bells.—This type of bell has now come into almost universal use, owing to the convenience with which the wires which conduct the currents can be carried behind skirtings, or under floors in any direction, and round any angles however acute or obtuse.

button at the centre of the push is pressed it brings the two springs into contact, then forming a passage for the current. Pushes are made in various patterns and forms. Some are made to place under a dinner-table near the carver's chair, so that a bell may be rung by pressure of the foot. Fig. 253 shows a pull suitable for a front door or gate post, in which the contact is made by drawing a piece of metal, attached to the handle of the pull, between two flat springs. Pushes are fixed to plugs in the wall in convenient positions.

Batteries.—These are contrivances for generating the necessary current for working the bells and indicators. The battery most suited for this purpose is composed of a number of cells, known as Leclanché cells, which will remain in good order for three or four years with very little attention. These cells are composed of two poles, one of zinc and one of carbon, immersed in an *exciting fluid* consisting of a solution of ammonium chloride in water. The carbon pole is surrounded by small particles of manganese dioxide, for oxidising the bubbles of hydrogen which accumulate round the carbon pole when the current is flowing and checks the action of the cell. These cells are connected up *in series*, *i.e.* carbon to zinc; the remaining four poles at either end of the battery being connected one to the bell and one to the indicator, as shown in Fig. 251.

In large systems of bells secondary batteries are used, *i.e.* so-called accumulators, or cells which have to be recharged from time to time from some external electric supply. These cannot therefore be conveniently used unless the building is fitted with electric light, when two sets of batteries must be employed, one being for use while the other is recharging.

Bells.—The bell shown in Fig. 251, and known as

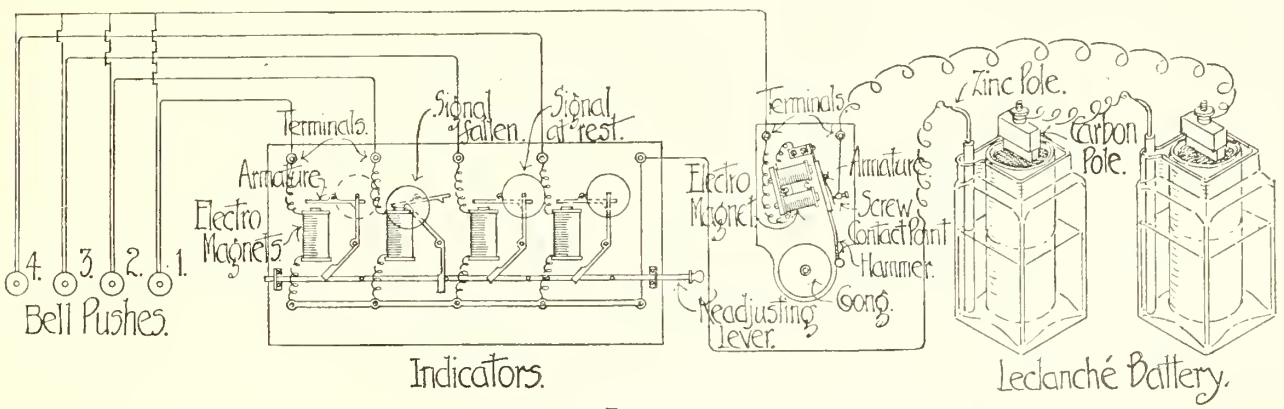


Fig. 251.

Fig. 251 shows a bell and indicator system suitable for ordinary domestic purposes, consisting of *pushes*, *batteries*, *bells*, *indicator*, and *wires*.

Pushes.—The construction of an ordinary bell-push is shown in Fig. 252. Its use is to complete an electric circuit, in order that the bell may ring. A gap is made in the circuit on the push, each of the two ends of the wire being connected to one of the two metal springs which are secured to the base of the push. When the

the *Trembling Bell*, is the type of bell most suitable for ordinary domestic purposes. When any push is pressed the current flows from the carbon pole of the battery, through the right-hand terminal of the bell, to the contact screw through a spring to the electro-magnets, which immediately become magnetised, and attract the soft-iron armature to which the hammer is attached, thus imparting a blow to the gong. The armature, being drawn towards the magnet, draws the

spring away from the contact screw, thus breaking the electric circuit, when the magnet immediately becomes demagnetised, and the armature flies back to its original position. This whole process, being repeated, causes the hammer to vibrate against the gong so long as the push is being pressed.

Single-stroke Bells are sometimes used in which the contact screw is dispensed with, the carbon pole being connected directly to one end of the wire forming the electromagnet, which attracts the armature when the push is pressed, causing the hammer to impart a single blow to the gong.

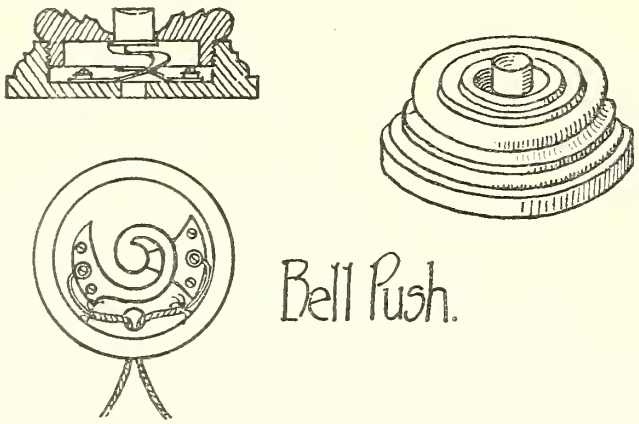


Fig. 252.

A type of bell known as the *Continuous Ringing Bell* is shown in the upper part of Fig. 255, in which case the armature of the upper electromagnet is attracted as soon as a push is pressed. This releases the lever L, which flies into contact with the contact point P, thus causing the current to pass round the lower electromagnets when the bell rings, until it is stopped by pulling the cord K, so as to reset the lever L in its original position.

Indicators. — These are used to indicate the room

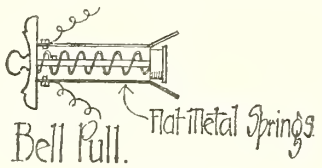


Fig. 253.

from which the signal was given. In Fig. 251 it is assumed that the push No. 2 has been pressed, when the current has flowed from the battery through the bell and push to the second electromagnet from the left on the indicator, and back to the battery; and in doing so it has energised that electromagnet, which has attracted the armature and allowed an enamelled disc bearing the number or name of the room which contains push No. 2 to fall forward and appear behind a small glass window in the cover of the indicator board. The indicator signal is replaced by pressing a knob at the right-hand side of the indicator. It should be noted that an electric circuit is only complete when there is a way for the current to flow out from the carbon pole back to the zinc pole of the battery.

Wires. — The wires used for conduction of the current used for electric bells are of copper, not less than No. 20 S.W.G., well tinned, and covered with gutta-percha or indiarubber, over which a double layer of cotton or silk is wound or plaited; and they should be well soaked in paraffin wax before use. When joints have to be made in wires, a short length of each end to be joined should be stripped of its insulating material, and the bare ends should be twisted and thoroughly soldered together, and bound round with strips of gutta-percha, which should then be warmed and passed tightly round the wire.

The wires are often fixed to convenient woodwork behind skirtings and along floor joints by means of wire staples. In better class work the wires are encased in thin iron tubes or run along walls behind picture nails or special wood casing, as shown in Fig. 254.

A complete *Hotel System of Bells* is shown in Fig. 255, where it will be noticed that when any push is pressed not only is a continuous ringing bell and the room indicator on the same floor set in action, but a bell

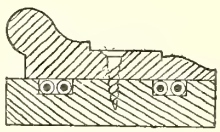


Fig. 254.

and an indicator in the hotel bureau is set in action at the same time.

The upper bell with its battery, indicator, resetting battery and push are all fixed in the attendant's room on the first floor, while the lower bell battery and indicator are fixed in the hotel bureau, which is usually on the ground floor.

The bell on the floor continues to ring until it is stopped by pulling the cord K, while the bell in the bureau rings only when the push is pressed.

The indicators used in this system are of a different type to those used in a domestic system. Thus when push No. 1 is pressed the current passes from the lowest battery through the indicator coil, and the armature attached to indicator No. 1 is attracted towards the coil, where it remains whether a current is passing or not, owing to the pivot upon which it is supported being a little below the centre of gravity of the armature and its disc. In this position the number on the indicator signal appears before an aperture in the indicator casing. The attendant, before attending to the call, presses the push connected with the resetting battery, which passes a current through all the coils R, thus drawing any displaced indicators back to their original position, indicating to the bureau attendant that the call has been attended to.

It should be noted that all the coils marked C are used for moving the signals, so that its number appears

before the aperture in the indicator case, while the coils marked R are all used to reset the signals.

All the ends of the wires forming the electromagnet should be connected to terminals such as T, or to screws in strips of copper D, as these make more reliable joints, offering the least possible resistance to the passage of an electric current. Should there be a

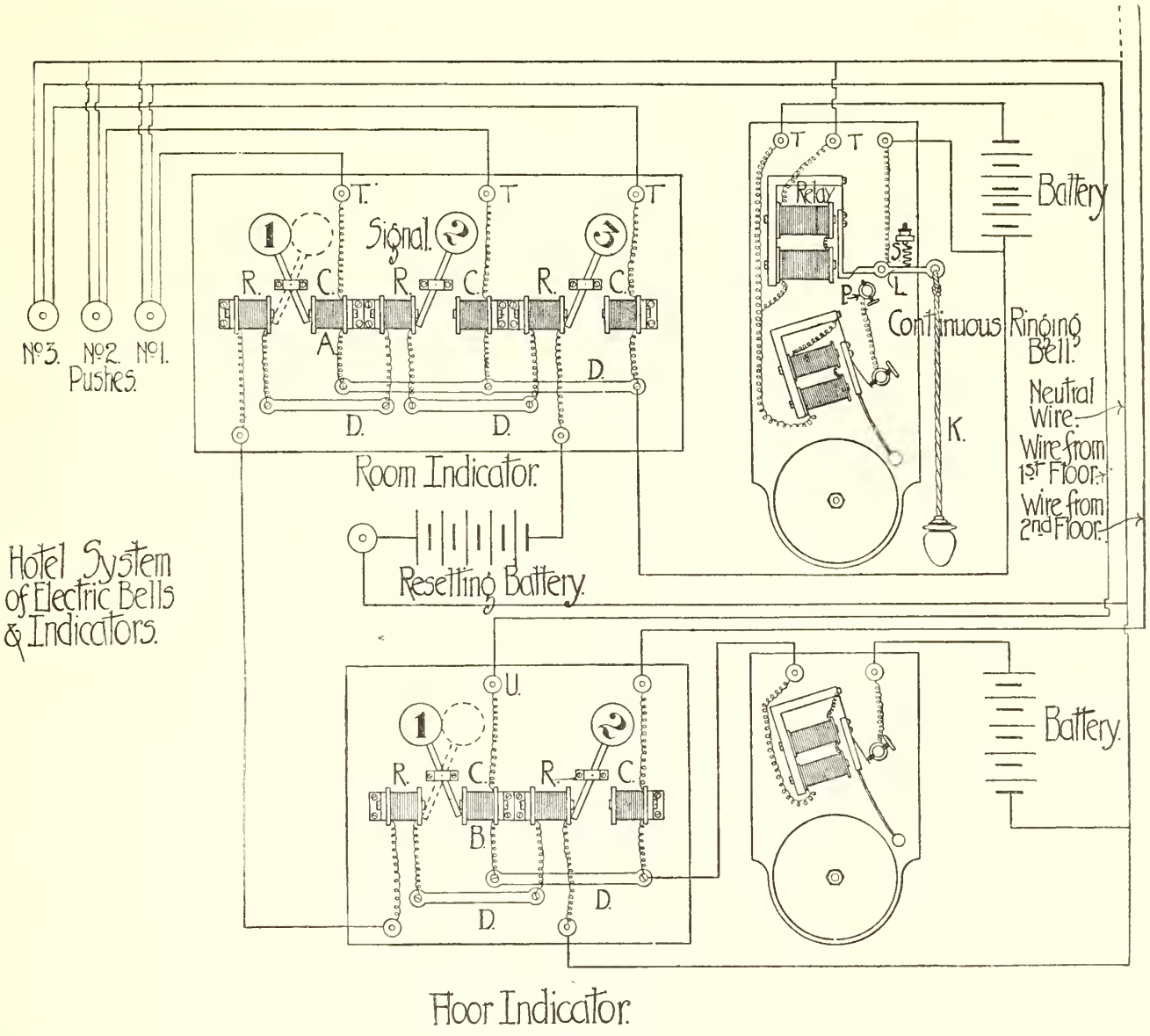


FIG. 255.

number of floors it is only necessary to repeat the arrangement as shown for the first floor.

It will be noted that there are two separate wires from each floor to the bureau, one for the main circuit and one for the resetting circuit, while a wire called the *neutral wire* connects all the floors to the bureau.

3. PNEUMATIC BELLS.—These are used to a considerable extent at the present day, and indeed they possess many advantages under certain circumstances over either mechanical or electric bells. The power used for working these bells is compressed air, but no more labour or inconvenience is required for forcing this compressed air than that of the pressure of the finger upon a push, fixed to the wall or in any other convenient position. These pushes consist of a casing similar to that of an electric push, an indiarubber ball taking the place of the spring. A slight pressure on the central button compresses the air within the indiarubber ball, causing it to enter a small metal tube to which the ball is connected. At the other end of the tube a bell is fixed, which is actuated by a small bellows being inflated by the air which issues from this end of the tube. This kind of bell remains in good order for a considerable length of time, and only needs the rubber balls of the pusher replaced about once in five or six years.

CHAPTER XIII

PLASTERER

(*Contributed by H. V. Margary.*)

Plastering may be defined as the covering of walls and other surfaces with any calcareous compound. In external work the operation is completed in two layers or coats, whilst internal work requires three coats.

The operations can be summarised as follows :—

	External Work.	Internal Work.
1st coat . .	Rendering.	Pricking up.
2nd coat . .	Floating.	Floating.
3rd coat		Setting.

Preparation of Surfaces.—In the application of plaster to external or internal walls it is first necessary to make the surface rough, in order that plaster may obtain a good key. This is obtained by raking out the joints of the brickwork and hacking the surface of the bricks. In cases, however, where the bricks are rough in texture this is unnecessary, and the plaster can be applied direct.

It can, however, readily be seen that it would be impossible to plaster direct on to floor joists or the quartering of wood partitions. They must therefore be prepared and rendered suitably to receive the plaster, and the preparation used must be of such a nature as to present a rigid surface, and at the same time form a good key. This is called lathing, and consists of nailing thin strips of wood (called laths), expanded metal, or wire, on which the plaster can be laid or pressed, so that it is forced through the interstices and protrudes on the back, thus forming a good key when dry.

Wood laths are generally adopted. These are of two kinds, rent and sawn, of oak or fir. Rent laths are prepared by being split from the log, so that the fibres are continuous throughout their length. They are rent in three thicknesses, known as—

Single laths .	$\frac{3}{16}$ inch thick	1 inch wide.
Lath and half .	$\frac{1}{4}$ „	
Doubles . .	$\frac{3}{8}$ „	

Oak laths have a tendency to warp, and are not often used.

Sawn laths are similar to those above described, differing only in the fact that they are sawn, and are therefore more uniform in size.

The length of a rent lath is from 2 feet to 3 feet 6 inches, while sawn laths are generally about 2 feet long.

Although sawn laths are much used on account of cheapness, rent laths should be employed in all good work.

Laths should be fixed about $\frac{1}{3}$ inch apart with iron clout nails from $\frac{3}{4}$ to $1\frac{1}{4}$ inches in length. These may be galvanised, wrought, or cast. The first named are preferred for fixing oak laths. Many architects object to the use of iron nails, on account of their rusting and staining the work, and in any case it is wise to paint or gas tar the heads of the nails before the first coat is put on. Zinc nails are often used to remedy this defect, but they are expensive as compared with those of iron.

Brandering and Counterlathing.—As it is imperative that the key of the plaster should not be broken by a greater width than 2 inches. Where laths cross timbers of a greater thickness than this, a good key may be obtained by nailing strips of wood, 1 to $1\frac{1}{2}$

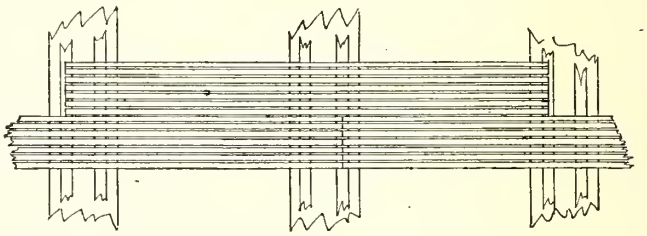


Fig. 256.

inch wide by $\frac{1}{2}$ inch in thickness, to the joists if under a floor, as shown in Fig. 256, or to the studs on a partition, and the laths are then nailed to these. This is called brandering.

Another method of overcoming the difficulty is to nails laths, called counterlaths, along the joists or studs in the direction of their length, and then nail the laths to these.

As it is the object of all architects to render buildings as fire-resisting as possible, wire netting is often used to receive the plaster. The netting should be galvanised, about $\frac{3}{4}$-inch mesh, and secured to the woodwork by small galvanised staples. It can also be used effectively where girders and columns have to be encased in plaster, and should then be secured by being wired to its support.

Expanded Metal Lathing.—Among the many forms of metal lathing now on the market, expanded metal (see Fig. 257) may be cited as a good example. This is made in sheets 6 feet by 2 feet, 7 feet

by 2 feet, and 8 feet by 2 feet 3 inches, and of three qualities—

	Approximate Weight per yard super.
No. 1—$\frac{1}{8}$-inch mesh, 24 B.W.G. . .	$3\frac{1}{2}$ lbs.
,, 26—$\frac{1}{4}$-inch mesh, 24 B.W.G. . .	$3\frac{1}{2}$,,
,, 77—$\frac{3}{8}$-inch mesh, 24 B.W.G. . .	$2\frac{1}{2}$,,
,, 78—$\frac{1}{4}$-inch mesh, 24 B.W.G. . .	$2\frac{1}{2}$,,

The lathing should be securely fixed, so as to ensure a level and rigid surface to receive the plaster.

To obtain the strongest and stiffest ceilings, the metal should be fixed the long way of the meshes across the supports. For ceiling or wall work the bearers may be from 12 to 14 inches apart. To these the lathing should be fixed by wire or clips if to ironwork, or by staples if to woodwork. If the supports are more than 14 inches apart a stouter gauge should be used.

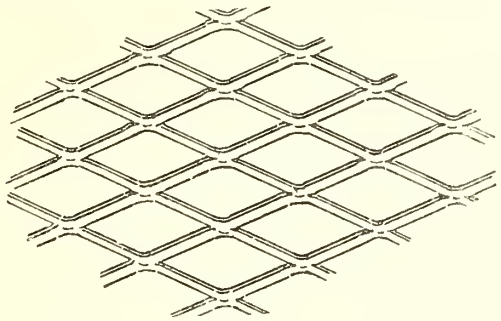


Fig. 257.

Where joints are made in the sheets they should be lapped. If the lathing is rigidly fixed the thickness of plaster need not exceed half an inch. The lathing used for plaster is given one coat of oxide of iron paint before leaving the works, but it is also sent out galvanised if required.

Apart from the superior key it affords, the plastering done on this lathing is practically fire, damp, and insect proof, and fire tests up to 2000° Fahr. have failed to remove the plaster or damage the metal.

Sand.—To ensure good plastering good sand must be used, preferably Leighton Buzzard standard sand, which may be obtained from many pits in that neighbourhood. It should be clean, sharp, and hard. From practical experience it has been found that the size of the grains does not influence the strength of the mortar, although fine plaster requires fine sand.

As sand is cheaper than lime, care should be taken that too great a proportion is not used. The usual proportions are one part of lime to two parts of sand. On this point no hard and fast line can, however, be laid down, as the proportions vary with the fatness of the lime and other circumstances.

Sand is used in plastering—

(1) To produce regular shrinkage and prevent cracking.

(2) To enable the air to get into the plaster and crystallise it.

(3) To increase its bulk.

The different kinds of sand used are—

Pit Sand.	Sea Sand.
River Sand.	

Of these pit sand is the best, next to it comes river sand, but sea sand should never be employed (unless it is impossible to obtain either of the other two), as the salts in it sooner or later discolour the wall paper, paint, etc., and render the wall damp, unless they be thoroughly worked out in running water—a tedious process.

Materials.—The limes principally used for internal plastering where strength is not required are calcined carbonate of lime (known as fat lime, pure or rich lime) and, in London, chalk lime.

Hydraulic limes require only their own chemical composition of lime and silica to make them set, for they are able of themselves to set and harden under water. Natural hydraulic limes are obtained from Warwickshire, Leicestershire, and other places in the British Isles, whilst artificial hydraulic limes are made by mixing a sufficient quantity of clay with fat or chalk limes. The lime may either be mixed with clay and burnt raw, or may be burnt, slaked, ground, and afterwards mixed with clay and reburnt. The latter is the more usual method. Too much care cannot be taken in slaking lime, as, if this operation is not thoroughly performed, slaking will take place after use and form blisters in the work. $1\frac{1}{2}$ gallon of water will slake 1 bushel of lime.

Cements may be divided into two classes—natural and artificial.

An example of the former is Roman cement, made by calcining the nodules found in the London clay and then grinding them to a fine powder; but it has now been almost entirely superseded by Portland cement.

Portland cement with a large proportion of sand is much used both in internal and external work, and also as a backing for the various white cements. It is unnecessary to slake Portland cement with water. In place of this it should be spread on a wood or concrete floor under cover for some weeks until thoroughly air slaked, to prevent the cement blowing in the work.

Cement mortar or plaster should be used as soon as it is mixed, and never after it has once set.

Plaster of Paris is known to the trade as *Plaster*, and is manufactured by gently calcining gypsum (which is largely found near Paris) after grinding. It is principally used for mixing with ordinary fat lime plaster to make it set quicker.

As plaster of Paris is extremely soluble in water, it should only be used in internal work, and great care should be exercised in keeping the air from it, as the moisture deteriorates it.

It is also largely used for cornices and cast ornaments, and for stopping holes in existing work, owing to its property of expansion and its quick-setting properties.

The proportion of ordinary stuff to plaster of Paris varies from 1 in 4 to 1 in 20, depending on the state of the weather and the speed with which the work has to be finished.

The following artificial cements have plaster of Paris as their base. They can be used where hardness, quick drying, and a fine or polished surface is required.

Parian Cement is composed of gypsum mixed with borax and cream of tartar and afterwards calcined. It is made in two qualities, coarse and superfine, and sets with a hard surface in from four to five hours.

Keene's Cement is made of gypsum, with the addition of alum (1 part to 12 of water at 95°). After a thorough mixing it is baked to drive off the water. It is supplied in two qualities, coarse and superfine, sets very hard, and is used in positions subject to hard usage.

Martin's Cement consists of gypsum and 1 lb. pearl ash dissolved in 1 gallon of water with a small proportion of sulphuric acid.

Sirapite is in composition similar to plaster of Paris, and is made from gypsum impregnated with petroleum, which is found in Sussex and Derbyshire.

Selenetic Cement is sulphate of lime (plaster of Paris) added to a lime possessing hydraulic properties, thus forming a rapidly setting cement which can be used with advantage as a backing for the white cements such as Parian.

Adamant has as its base gypsum and sand and fine sawdust, together with small proportions of dry glue, carbonate of soda, and borax. It can be readily applied, and dries quickly.

Robinson's Cement is composed of gypsum, with a mixture of tinal (an imported material) and alum. It is one of the best fire-resisting plasters, and is less costly than Keene's or Parian.

Mastic is used to point the joints between wood frames and the brickwork or stonework, and is heat-resisting, tenacious, and adhesive. It is made of stone powder, litharge, and linseed oil. A good mastic can also be made of two parts white lead, three of sand, and three of lime, thoroughly mixed with linseed oil.

Hair is mixed with the first coat of plaster on ceilings and partitions to bind the plaster together. It should be long, curled, strong, and clean cow hair, well separated before being mixed with the plaster; and care should be taken that it is not broken during the process.

Plasterer's Putty, or *Putty*, is made by simply slaking and straining lime through a sieve of 256 meshes to the square inch into a "putty bin," where it is left until it has attained the required consistency. In this state it will keep for a long time if kept moist.

Fine or *Setting Stuff* consists of slaked lime mixed with fine sand in the proportions of one part of putty to two parts of washed sand, used to allow the carbon dioxide to more readily enter the plaster and cause it to set.

Gauged Stuff is coarse putty or setting stuff mixed with plaster of Paris. This enables the plasterer to lay on several coats in internal work in rapid succession, as the addition of the plaster of Paris causes it to set very rapidly. The proportion of plaster of Paris used varies from 1 in 2 to 1 in 4.

Mixing and Application.—*Coarse Stuff* is made by hand, and is a mixture of fine clean sand, chalk lime, and long sound hair.

The lime is first slaked in the following manner:—It is put in a large tub or vat and well stirred about until it slakes. When the slaking is completed it is then taken out of the tub and run through a sieve (of about 64 meshes to the square inch) in a creamy state into a wood bin, where it should be allowed to stand for at least a fortnight. When required for use the hair and sand are added, the former having been previously well beaten with a stick to separate it. The whole is then thoroughly mixed together with a long two-pronged fork called a "hair hook."

Coarse stuff is frequently made by grinding brick rubbish in a mortar mill, and afterwards adding lime and hair. The lime should be slaked and strained before being put into the mill, and the hair should on no account be added until the other contents of the pan are ground. The whole is then turned out as soon as the hair is thoroughly mixed. Care must be taken not to leave it in the pan too long, or the hair will be ground up, and then not perform its proper function. The proportions are—

One part lime, two or three parts sand, and one pound of hair to 3 cubic feet of coarse stuff.

Plastering is described as follows—

On Walls—

1st coat	. . .	Rough rendering.
2nd coat	. . .	Floating.
3rd coat	. . .	Setting.

On Lath—

1-coat work—Lath and lay or lath and plaster one coat.

2-coat work—Lath, lay and set, or lath and plaster and set.

3-coat work—Lath, plaster, float and set, or lath, lay, float and set.

The first and second coats on walls and ceilings are put on with a steel trowel (see Fig. 258), the only difference being that the first coat on the ceiling is pricked up with a wooden pricker, which scores the plaster with lines, and forms a key for the second coat.

In places subjected to hard wear, as angles of chimney jambs, etc., and where a smooth, hard surface is required, Keene's and Parian cements can be strongly recommended.

As the ordinary lime backing coats cannot be used, it is necessary under these circumstances to use cement and sand in the proportion of 1 to 2 put on in two coats, making a total thickness of $\frac{1}{4}$ inch. The setting coat, about $\frac{1}{8}$ inch, is then put on with a wood float and worked to a smooth surface with a steel trowel.

Fibrous Plaster is now extensively used for covering ceilings and forming cornices. It is a preparation of plaster of Paris on canvas, from $\frac{1}{2}$ inch thick, and sometimes strengthened by wood laths at the back. The slabs are sent out in sizes about 2 feet 6 inches by 3 feet, which are fixed to the ceilings and partitions with compo nails and washers or brass screws.

Cornices, mouldings, and casings for columns are

made in a similar manner. They are delivered on the job in convenient lengths, and the joints made good with plaster of Paris modelled to match the existing moulding. This method is strongly recommended, as it is far cleaner than running cornices by hand.

Cornices are also run *in situ*. The ceiling and walls moulds in convenient lengths and afterwards bedded or screwed in position.

The most artistic work is modelled *in situ*, the plastic being gauged to retard its setting, but in most cases the cost precludes the use of this method.

Rough Cast is the name given to plastering on

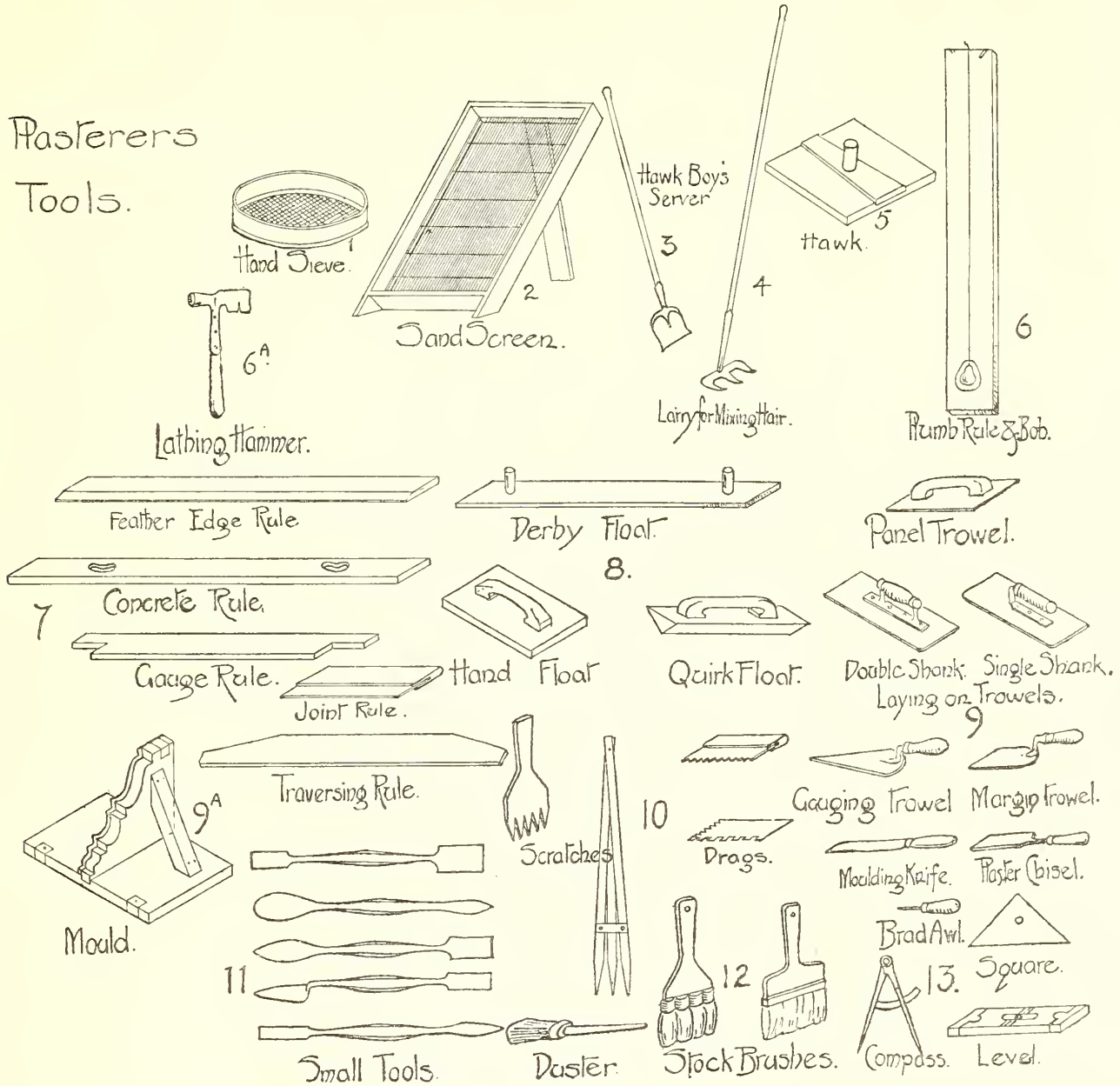


FIG. 258.

are bracketed out as required to fit the profile (see Fig. 259), and plaster of Paris put on to block them out to a rough outline, and the mouldings are run by a wooden "horse" (see Fig. 258), to which is attached a zinc profile of the cornice to be run. The horse is kept in position by a wood screed fixed at the bottom of the cornice and by a plaster screed on the ceiling.

Cornices and enrichments are also cast in wax

external walls when finished with rough pebbles, about $\frac{1}{4}$ inch to $\frac{1}{2}$ inch sand or grit, mixed with lime or cement, and dashed on the second coat while still wet.

If the finished surface is required to be white, chalk is mixed with the lime, or Russian tallow and copperas; but on no account should the rough cast, when dry, be lime-washed or coloured, or a very sticky appearance will result from the rain running down and carrying the

colouring with it. If, however, any colour but white is required, the colouring matter should be mixed with the finishing coat.

Depeter.—In this form of rough cast the gravel is pressed in by hand to patterns which may be formed by different coloured stones pressed in with a float.

Compo or cement rendering is the covering of large surfaces, such as the fronts of houses, with a mixture of Portland cement and sand. The joints of the brickwork are first raked out to a depth of $\frac{3}{4}$ inch, and the surface is hacked to form a good key for the first coat. For new work the external face of the wall should be built in rough stocks with protruding joints. The dust is next removed from the wall, which is then brushed down with a hard brush, and the surface wetted to assist the adhesion of the cement.

In new work the external face of the wall should be built in rough stocks with projecting joints. Rules, which are strips of wood about 1 inch thick, and pro-

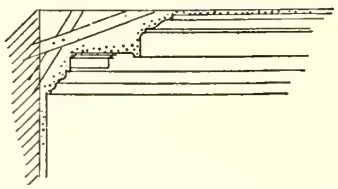


Fig. 259.

jecting $\frac{1}{2}$ to $\frac{3}{4}$ inch in front of the wall, are next nailed to the vertical edges of the wall, and these will act as a guide for the thickness of the first coat.

The wall is then spaced into bays of from 4 to 10 feet, and screeds, of the same material as the rendering coat, and equal in thickness to the projection of the rule, are then put on the wall and brought into line with the rules by means of a straight edge, and afterwards tested by stretching a line from end to end of the front to be composed.

In some cases nails are driven into the joints of the brickwork, and used in place of the screeds and tested in the usual way.

When the screeds are sufficiently hardened the walls between the screeds are rendered and brought to a face with a straight edge, working first from one rule to a screed and then from screed to screed along the face of the wall.

In most cases the face of the rendering coat is rough enough to receive the fining if suitable sand has been used. If, however, the sand has worked too smooth the face should be scraped with a ragged rule, or swept with a stiff broom.

The finishing coat, or "fining," should be put on before the first coat has thoroughly set. The two coats will adhere much better when the first coat is quite dry.

The fining or finishing coat is about $\frac{1}{8}$ inch thick, and is put on and brought to a uniform surface with a short traversing rule or float, and finished with a hand float. Inferior work is laid on and finished with a hand float.

Should the work dry too quickly, water must be splashed on with a brush and the surface hand floated until the glossy appearance has totally disappeared.

The work is then finished by being lined out to imitate blocks of stone. Lines are ruled with a jointer on the face, $\frac{1}{8}$ inch wide and $\frac{1}{8}$ inch deep before the fining is set,—this is called "ironing in," and makes a good clean and weather-proof joint.

The usual proportions of the rendering coat are—

1 Portland cement.
3 or 4 parts sand.

And the fining coat—

1 Portland cement.
1 to 2 parts sand.

Cornices and *Mouldings* are run as follows:—The rule is fixed at the top for the "nib" and one at the bottom for the "slipper" of the "horse" to run against, the brickwork having been previously profiled to the rough shape of the cornice or moulding. The material is laid on gradually, and the horse is frequently run along the rules and the moulding thus brought into shape. It is then finished with hand floats of different sizes and shapes on a joint rule. As the fining coat is difficult to keep on the floats, it is a great temptation to kill the stuff (*i.e.* by allowing it to set and knocking it up again) in order to make it work easier. This should never be allowed, as it is very detrimental to the strength of the work when finished.

The following are useful tables in connection with Plastering:—

One yard rendering requires—

$\frac{1}{3}$ cubic foot lime.	$2\frac{1}{2}$ ozs. hair.
$\frac{1}{2}$ cubic foot sand.	$1\frac{3}{4}$ gallon water.

One yard render and set requires—

$\frac{1}{2}$ cubic foot lime.	3 ozs. hair.
$\frac{1}{2}$ cubic foot sand.	2 gallons water.

One yard two coats and set requires—

$\frac{3}{5}$ cubic foot lime.	3 ozs. hair.
$\frac{2}{5}$ cubic foot sand.	$2\frac{1}{2}$ gallons water.

One yard render and float requires—

$\frac{1}{2}$ cubic foot lime.	$2\frac{1}{2}$ ozs. hair.
$\frac{3}{4}$ cubic foot sand.	$2\frac{1}{2}$ gallons water.

One yard render, float and set requires—

$\frac{3}{5}$ cubic foot lime.	$3\frac{1}{2}$ ozs. hair.
$\frac{3}{4}$ cubic foot sand.	$2\frac{3}{4}$ gallons water.

2 bushels grey stone lime equals . 1 bag
3 bushels blue lias lime equals . . 1 bag
2 bushels Portland cement equals . 1 bag
14 lbs. plaster of Paris equals . . 1 bag

1 lb. of hair is allowed to 2 cubic feet of coarse stuff for good work, and to 3 cubic feet for common work.

$1\frac{1}{2}$ cubic foot lime will once lime wash over 100 yards super.

2 cubic feet lime will twice lime wash over 100 yards super.

Printed by Hazell, Watson & Viney, Ld., London and Aylesbury.

GETTY CENTER LIBRARY
3 3125 00700 7467